

REFERENCE COPY

SAI 9200591 19200591

CIM 204.90 / December 1991

# A Comparison of Long-Range Bombers and Naval Forces

David A. Perin

DO NOT DESTROY  
30 DAYS LOAN  
RETURN TO AFSAA/SAMI  
1777 NORTH KENT STREET, 7th FLOOR  
ROSSLYN, VA 22209. (703) 588-6940

Cleared for Public Release  
Distribution Unlimited

Distrib  
Other

IENT:  
-0002.  
P-08).

28718  
CNA

CENTER FOR NAVAL ANALYSES

4401 Ford Avenue • Post Office Box 16268 • Alexandria, Virginia 22302-0268



Legacy Number: 9200591 19200591

20101015333



Work conducted under contract N00014-91-C-0002.

This Information Memorandum represents the best opinion of CNA at the time of issue.  
It does not necessarily represent the opinion of the Department of the Navy.

# **A Comparison of Long-Range Bombers and Naval Forces**

David A. Perin

*Force Structure Division*



---

**CENTER FOR NAVAL ANALYSES**

4401 Ford Avenue • Post Office Box 16268 • Alexandria, Virginia 22302-0268

---



## ABSTRACT

In response to a report by the Senate Armed Services Committee, this information memorandum examines the basic issues involved in comparing long-range bombers and naval forces and makes some simple quantitative comparisons between the B-2 bomber and the proposed A-X aircraft in cases where they compete head to head.



## CONTENTS

	Page
Introduction .....	1
Tradeoffs at the Margin .....	5
Reduce Forward Deployments? .....	6
Reduce Number of CVBGs? .....	13
Modify Air-Wing Composition? .....	20
Cost-Effectiveness Comparisons .....	22
Cost .....	23
Effectiveness Factors .....	26
Survivability .....	27
Target/Mission Application .....	33
Payload Delivered .....	38
Strike Effectiveness Scorecard .....	51
Concluding Discussion .....	53

## INTRODUCTION

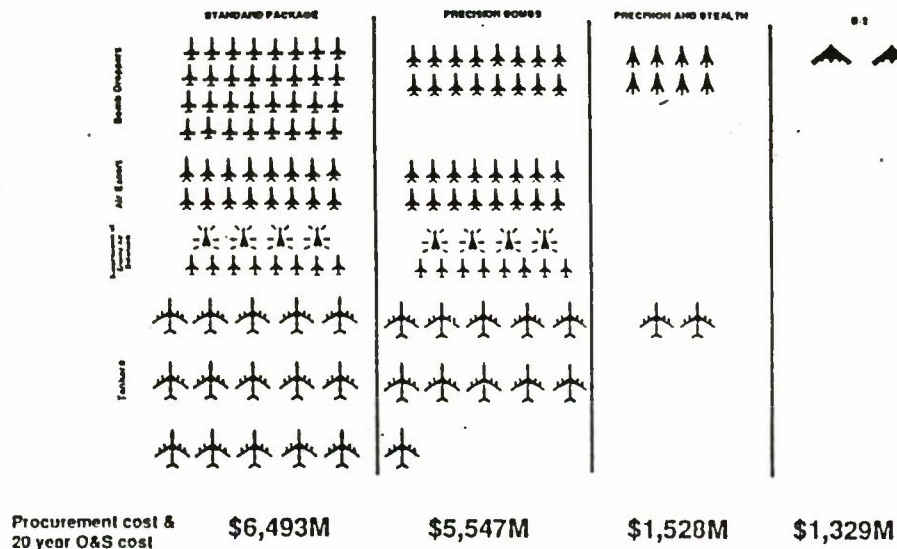
With the demise of the Warsaw Pact and the decline in U.S. defense budgets, pressures are building to reconsider long dormant issues about the roles and missions of the Armed Services, particularly the nation's three major air arms--strategic bombers, land-based tactical aircraft, and naval aviation. An example of these pressures is a recent Senate Armed Services Committee (SASC) report that calls for potential reductions in other programs to fund more rapid production of the B-2 bomber and an examination of other "tradeoffs at the margin".

In response to the SASC report, this information memorandum examines the basic issues involved in comparing long-range bombers and naval forces and makes some simple quantitative comparisons between the B-2 bomber and the proposed A-X aircraft in cases where they compete head to head. The remainder of this introductory section sets the stage by summarizing the SASC report on the B-2 and its call for DOD to investigate tradeoffs at the margin. The second section examines the three suggested tradeoffs that involve naval forces. The third section presents some quantitative comparisons of the B-2 and A-X, and the final section summarizes the main themes of the analysis. The paper is presented in the format of an annotated briefing with charts and explanatory text.

DO NOT DESTROY  
30 DAYS LOAN  
RETURN TO AFSA/SA/  
PENTAGON, RM 1D363



## WHAT THE B-2 OFFERS



*And the B-2 can do jobs no other aircraft can do....*

From Air Force stealth-week handout,  
reprinted in the SASC report.

The origin of this work can be traced to the above figure, which was distributed by the Air Force during the "stealth week" promotion of the F-117 and B-2. The graphic illustrates the basic arguments for stealth and for the long range and large payload of bombers. These arguments impressed the SASC with the value of stealth in general and the B-2 in particular. The SASC report states: "As the F-117A demonstrated during Operation Desert Storm, stealth technologies add an entirely new dimension to the art of war. Stealth has returned the factor of surprise to air operations. The B-2 offers all the advantages of the F-117 and more: greater range, significantly more payload, more comprehensive low observability, all-weather capability, and enormous growth potential."

The SASC report also notes the potential cost effectiveness of the B-2 compared with non-stealthy aircraft. Although, individually, the B-2 is very expensive, it may be less expensive than the number of non-stealthy aircraft needed to carry out the same mission. This observation led the SASC to suggest that DOD investigate "tradeoffs at the margin" involving various other forces, including naval forces.

## **COST SAVINGS FROM TRADEOFFS AT THE MARGIN**

**"The committee [SASC] believes there are a number of categories under which tradeoffs at the margin should be conducted. ... Some exemplary questions are:"**

- "If the B-2 can arrive at crisis scenes within hours, do we need as many forward-deployed carrier task forces?"**
- "If the full force of B-2s with worldwide range and rapid arrival is acquired, how many carrier air wings and carrier battle groups will be needed?"**
- "If B-2s can assume part of the early attack mission, how many attack aircraft does the Navy need to replace? Would a different mix of non-stealthy A-6 and F-18 aircraft be acceptable?"**

This chart summarizes the SASC tradeoffs that involve naval forces. The full list of possible tradeoffs was quite broad, involving tactical aircraft, heavy Army divisions, and the C-17 as well as naval forces. This paper focuses on the three tradeoffs involving the Navy--decreasing forward deployments by carrier battle groups, reducing CVBG force levels, and changing the composition of aircraft in the carrier air wing.

The next two sections examine these tradeoffs and present some related quantitative analysis. Before embarking on the discussion, however, it is worthwhile noting the context for the current debate and recognizing the inherent difficulties in addressing such emotionally charged issues. Even before the recent problems in the B-2 program, the SASC position on the B-2 did not represent a consensus view of Congress. In fact, the House Armed Services Committee (HASC) had staked out roughly the opposite position, as indicated by the quote from Representative Les Aspin on the next chart.



## **Rep Les Aspin**

**- LA Times 29 July 1991 -**

**The number of B-2s required for the conventional role in any likely post-Cold War contingency is much lower than the numbers previously considered for the nuclear role. . . . I do not believe the case has been made to go beyond the 15 planes already approved by Congress.**

The above quote is from an op-ed piece that appeared 29 July 1991 in the *LA Times*. It is representative of the HASC's opposition to DOD's proposal to procure a force of 75 B-2s. The HASC has argued that the B-2 is too expensive, that the rationale for the aircraft has changed repeatedly, and that the money would be better spent on ICBMs and various conventional systems such as the V-22. The problems that were identified in recent B-2 stealth tests and the changes in U.S. nuclear posture strengthened the HASC's position in the conference committee, which funded continuing development of the B-2 but no additional production aircraft without approval of both houses of Congress.

Although the B-2 is far from dead, it seems unlikely that DOD will achieve the full force of 75 B-2s, let alone at an accelerated production rate as suggested in the SASC report. Nonetheless, as declining budgets force DOD to make ever harder choices, the types of the questions raised by the SASC report are likely to come up again, regardless of the eventual outcome of the B-2 program.

## **PART II**

### **TRADEOFFS AT THE MARGIN**

- **REDUCE FORWARD DEPLOYMENTS ?**
- **REDUCE NUMBER OF CVBGs ?**
- **MODIFY AIR-WING COMPOSITION ?**

This section examines the three tradeoffs mentioned in the SASC report that involve naval forces. In the first two cases, the discussion focuses on the differences between bombers and multipurpose carrier battle groups. The general theme is that CVBGs are not directly comparable to long-range bombers because they carry out a variety of missions and tasks besides bombing. A similar argument can be made for the third tradeoff because tactical aircraft possess certain attributes not shared by strategic bombers. However, there is a degree of overlap, which leads to the quantitative comparisons in the next section.



## **REDUCE FORWARD DEPLOYMENTS?**

- **FORWARD PRESENCE REMAINS A KEY ELEMENT IN U.S. NATIONAL SECURITY STRATEGY**
  - **U.S. RETAINS GLOBAL INTERESTS**
- **HISTORY AND CURRENT EVENTS CONFIRM NAVY ROLE**
  - **IN PEACETIME: A VISIBLE, FLEXIBLE DETERRENT**
  - **IN CRISES: FIRST IN – LAST OUT**
  - **LAND-BASED PRESENCE DECLINING**
- **BOMBERS DO NOT SUBSTITUTE FOR DEPLOYED FORCES**
  - **CANNOT PROVIDE SUSTAINED PRESENCE**
  - **DO NOT HAVE CAPABILITY FOR MANY CRISES**
- **MODEST COST (< 6% OF CVBG OPERATING COSTS)**

One tradeoff suggested in the SASC report is a reduction in forward deployments by naval forces in light of the B-2's capability to strike worldwide from the U.S. In August 1991, the President reconfirmed the U.S. strategy of maintaining forward-deployed forces, although the amount and type of presence may be changing in the post-Cold-War world. As the stationing of U.S. forces on foreign soil decreases, maritime forces will increasingly bear the responsibility for forward deployments. Long-range bombers cannot shoulder much of this burden because they cannot sustain forward presence and because bombing is not an option in most crises. Finally, once naval forces are procured, the additional operating and support costs attributable to forward deployments are small. Each point in this argument is examined in the following series of charts.

## **National Security Strategy of the United States**

**-- the White House, August 1991**

**"The four fundamental demands of a new era  
are already clear:**

- to ensure strategic deterrence**
- to exercise forward presence in key areas**
- to respond effectively to crises**
- to retain the national capacity to reconstitute  
forces should this ever be needed"**

In discussions about the importance of forward-deployed forces, there is often debate about the precise relationship between the means (i.e., the exact numbers and types of forces) and the ends (i.e., deterrence of aggression and promotion of regional stability.) But there is little doubt about the ultimate value of forward presence. The National Security Strategy of the U.S., which was issued in August 1991, lists forward presence as one of the four fundamental demands of the new era and confirms the basic rationale: "Maintaining a positive influence in distant regions requires that we demonstrate our engagement. The forward presence of our military forces often provides the essential glue in important alliance relationships and signals that our commitments are backed by tangible actions. Our presence can deter aggression, preserve regional balances, deflect arms races, and prevent the power vacuums that invite conflict." [ page 27]

In the above quotation, the White House is referring to forward-deployed forces in general, not just naval forces. It is clear, however, that the U.S. is reducing permanently deployed land-based forces in Europe and the Far East, so that the role of maritime forces is likely to become relatively more important.



## **BOMBERS IN PRESENCE MISSIONS, COMBAT, AND SHOWS OF FORCE SINCE THE VIETNAM WAR**

*(The USAF and National Security, SAF/OSX 1991)*

- AUG 76** "Following the murder of two army officers, . . . B-52s flew training missions along the DMZ to underscore U.S. concern."
- JAN 80** "B-52s overflew Soviet naval vessels in the Arabian Sea to demonstrate U.S. power-projection capabilities."
- OCT 81** " During Bright Star 82, . . . two B-52Hs [flew] a nonstop mission from North Dakota to a simulated runway target in Egypt."
- DEC 81** "In show-of-force missions in response to mobilization of North Korean forces, B-52 sorties were flown along the border."
- JAN 91** 70 B-52s fly combat missions in Operation Desert Storm.

Can bombers replace forward-deployed forces in the presence and crisis-response role? The historical record provides a starting point for discussion. The chart above, which is derived from recently published USAF data, lists the use of bombers in show-of-force missions and combat since the end of the Vietnam War. Only five incidents are listed in the USAF data and none between 1981 and Operation Desert Storm. During this period, CVBGs responded to over 50 international crises, which are summarized on the next page.

## CVBG Responses to Crises Since the Vietnam War

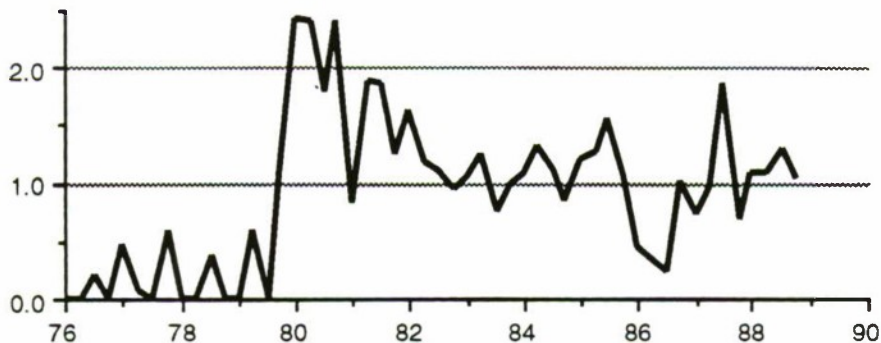
(Source: CNA Research Memorandum 90-246, Feb 1991)

Year	Crisis	CVs	Year	Crisis	CVs
1974	Cyprus	2	1983	Libya-Chad	1
1975	Cyprus Unrest	1	1983	Marine Barracks Bomb	2
1975	Eagle Pull, Cambodia	1	1983	Iran-Iraq	1
1975	Frequent Wind, Viet.	4	1983	Korea-Burma	1
1975	Mayaguez	2	1983	Grenada	1
1975	Lebanon	1	1983	Syria	1
1976	Kenya-Uganda	1	1984	Central America	1
1976	Korean Tree Incident	1	1984	Persian Gulf	1
1977	Uganda	1	1984	Saudi Hijacking	1
1978	Ogaden War	1	1984	Cuba	1
1978	Afghanistan	1	1985	U.S. Pers. in Lebanon	1
1978	Iranian Revolution	1	1985	TWA 847 Hijacking	1
1979	China-Vietnam	1	1985	Achille Lauro	1
1979	Yemen	1	1985	Egypt Air Hijacking	1
1979	Soviet Troops in Cuba	1	1986	OVL-FON Ops	3
1979	Afghan/Iran Hostages	2	1986	La Belle Disco, Libya	2
1979	Park-Chung Hee	1	1986	Pakistan Hijacking	1
1980	Korea	1	1987	Persian Gulf Ops	2
1980	Iran-Iraq War	2	1987	Hostages in Lebanon	1
1981	Syria	2	1988	Summer Olympics	2
1981	Libya	2	1988	Maldives Coup	1
1981	Sadat-Sudan	1	1989	Lebanon Civil War	1
1981	Central America	2	1989	Panama Elections	1
1982	Israeli Invasion	1	1989	China Civil Unrest	1
1982	Peacekeeping Force	2	1989	Hostages in Lebanon	2
1982	Palestinian Massacre	2	1989	Philippines	2
1983	Libya-Sudan	1	1990	Operation Desert Shield	6
1983	Honduras	1			

This chart lists CVBG responses to international crises since 1974. The size of the list is in marked contrast to the bomber involvement listed in the previous chart. There is a comparable imbalance in presence operations. For example, during the 1980s, a decade of near continuous turmoil and conflict in the Persian Gulf, bombers made only periodic training flights to the North Arabian Sea. Meanwhile, tactical forces were on-scene routinely. AWACS aircraft operated out of Saudi Arabia for several periods, and, as the next chart shows, naval forces were on-scene the entire decade.



### CVBG PRESENCE IN THE IO QUARTERLY AVERAGE



This chart shows the quarterly presence of carrier battle groups in the North Arabian Sea. (Additional naval surface forces were deployed in the Persian Gulf.) Before the hostage crisis, annual battle-group presence in the Gulf was limited to two 45-day periods, but events in the 1980s forced the Navy to maintain near-continuous presence. The causes were varied. First was the hostage crisis, then the Iraqi invasion of Iran, then the tanker war. Because of the hardships involved, the Navy attempted to draw down forces on several occasions, but, every time, events conspired to demand some new crisis response. Thus, bombers appeared in the Gulf only periodically, but naval forces were on-scene the entire decade.

The reasons for the disparity are clear. Bombers can reach out and bomb someone from a long distance, but cannot sustain presence. More important, in most situations short of major combat, bombing is not an option. During the entire 1980s experience in the Gulf, the U.S. did not mount a single bombing attack. The major tasks were air and sea surveillance, combat air patrol, convoy escort, antisurface warfare, mine countermeasures, and special forces operations--tasks that are not suited to bombers. A similar pattern holds in the overall crisis-response experience, as illustrated by the next chart.

## TASKS IN PEACETIME AND CRISES

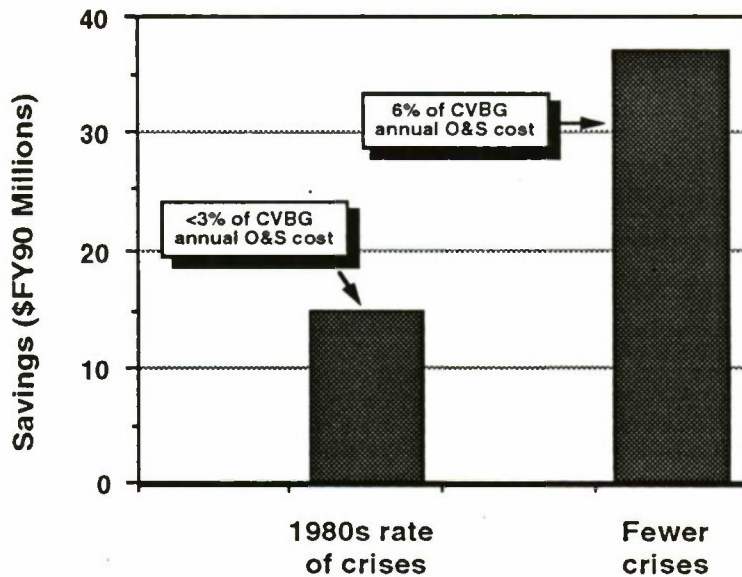
<u>MISSION</u>	<u>CVBGs</u>	<u>Bombers</u>
• PROMOTE REGIONAL STABILITY (e.g., routine deployments)	YES	NO
• PROTECT PEOPLE AND PROPERTY (e.g., Iran hostage rescue)	YES	NO
• MAKE A SHOW OF FORCE (e.g., Gulf of Libya ops)	YES	YES
• PROTECT, QUARANTINE, OR INTERDICT SEA/AIR TRAFFIC (e.g., Earnest Will convoy ops and capture of <i>Achille Lauro</i> hijackers)	YES	NO
• FORESTALL OR RESPOND TO HOSTILE OR TERRORIST ACTS (e.g., strikes at Libya)	YES	YES
• INTERVENE IN CONFLICTS (e.g., Grenada)	YES	SOME

A major reason for the frequent use of carrier battle groups and tactical forces is their suitability for a variety of crisis situations. This chart categorizes the types of crises that have involved U.S. forces since the Vietnam War. In each case, naval forces have been a major participant. The historical record shown earlier indicates that bombers were a factor only in the show-of-force category, and then only occasionally. Given appropriate weapons, bombers could contribute to the types of strike missions that were executed by F-111s in Libya and F-117s in Panama. (On the other hand, Tomahawk land-attack cruise missiles appear to be an even better choice for many types of isolated precision strikes.)

More to the point, however, bombing is not a relevant option for most crisis situations--for example, forcing down the aircraft carrying the *Achille Lauro* hijackers, protecting merchant shipping during the Gulf tanker war, or providing air cover and logistics support to various hostage and noncombatant rescue operations. A carrier battle group can contribute to all of these crises because of its multiple warfare capabilities. Forward-deployed land-based forces can also contribute to these missions, but overseas basing rights have been declining steadily, particularly in situations short of major hostilities. Thus, forward deployment of naval forces appears clearly desirable so long as the cost is not too high, which is addressed on the next chart.



### COST SAVINGS FROM ELIMINATING ROUTINE CVBG DEPLOYMENTS (Per CVBG per year)



This chart shows the effect of deployment posture on the direct operating and support costs per year for a carrier battle group, including the carrier, its air wing, surface combatants, and support ships. The figures include the pay and allowances for the crews, fuel, training ordnance, and maintenance costs. The baseline for the estimated savings is the normal operating cycle of six months deployed over a 20-month period. The chart shows the potential annual cost savings per CVBG for a posture in which CVBGs respond to crises but do not make routine forward deployments. The two cases in the chart represent different levels of crisis-response activity. Based on historical data from the 1980s, when the Persian Gulf, Libyan, and Lebanon crises dominated carrier deployments, crisis responses would have accounted for about three-fourths of the normal deployments, which is the first case in the chart. The second case in the chart illustrates a lower level of crisis-response activity that results in one-half the normal forward operating tempo.

The potential savings for the entire fleet amounts to several hundred million dollars a year, which adds up to real money over a period of time. Nonetheless, the amount represents less than 6 percent of operating and support costs, which clearly appears insufficient to justify giving up the stabilizing benefits of forward deployments and the ability to respond immediately to a variety of crises. Conceivably, further O&S savings might be possible--one standard suggestion, for example, is to place additional forces in the reserves--but big savings are achievable only by reducing force levels, which leads to the second tradeoff suggested in the SASC report.

## **REDUCE NUMBER OF CVBGs?**

- **CVBG PROVIDES MULTIWARFARE CAPABILITY**
  - PROMOTES STABILITY IN PEACETIME BY VISIBLE PRESENCE AND ABILITY TO RESPOND TO VARIED CONTINGENCIES
  - ON SCENE EARLY TO ENABLE JOINT OPS IN REGIONAL WAR
- **COMBINED ARMS CAPABILITIES REQUIRED IN CRISES AND REGIONAL CONFLICTS**
  - BOMBING IS NOT A PANACEA
- **STRATEGIC BOMBERS AND TACTICAL AIRCRAFT ARE COMPLEMENTARY AND SYNERGISTIC**

Reducing the number of carrier battle groups is a more serious proposal, if only because the money involved is much larger than for a change in deployment patterns. The fundamental argument against this tradeoff is straightforward: Bombers are good at bombing; carrier battle groups are good at a variety of military tasks that are essential across the spectrum of conflict. Bombing is important, but it is not a panacea for U.S. defense problems. The U.S. must maintain a combined arms military capability that can carry out a range of missions in peacetime, in a variety of crises, and in regional wars. That capability requires an Army, a Navy, a Marine Corps, and Air Force airlifters and tactical air forces, as well as a capable bomber force. Moreover, tactical air power and strategic bombers are complementary. Bombers can deliver large payloads from long range on short notice, providing mass and shock. Tactical aircraft on-scene can achieve high sortie rates, which provides rapid response and tactical flexibility. In addition, tactical aircraft can provide valuable strike support to bombers.



## **WARFARE CAPABILITIES**

<u><b>Warfare Task</b></u>	<u><b>CVBG</b></u>	<u><b>Bombers</b></u>
• <b>STRIKE WARFARE</b>	<b>YES</b>	<b>YES</b>
• <b>AIR SUPERIORITY ANTIAIR WARFARE</b>	<b>YES</b>	<b>NO</b>
• <b>ANTISURFACE WARFARE</b>	<b>YES</b>	<b>NO*</b>
• <b>ANTISUBMARINE WARFARE</b>	<b>YES</b>	<b>NO</b>
• <b>MINE WARFARE</b>	<b>YES</b>	<b>SOME</b>

\*B-52s can deliver HARPOON vs ship formations in the open ocean, but are not appropriate for inshore ASUW that is typical of regional conflicts.

This chart points out that a carrier battle group possesses multiple warfare capabilities, whereas long-range bombers are primarily a strike platform. A CVBG provides considerable strike potential in its attack aircraft and its Tomahawk land-attack cruise missiles. In addition, the battle group's fighters, surface-to-air missile ships, and airborne early-warning aircraft provide antiair warfare and air-superiority capabilities. Its destroyers, submarines, LAMPS helicopters, and S-3 ASW aircraft provide capabilities to counter enemy submarines--such as the German Type 209 submarines that are operated by many Third World countries adjacent to vital sea lanes. The battle group also has excellent antisurface warfare capabilities, and it includes a variety of intelligence, logistics, and surveillance capabilities.

Bombers are a good strike platform in terms of range and payload. They do not possess AAW or ASW capabilities, however, and they are not well-suited for the type of inshore antisurface warfare that is typical of crises and regional conflicts. In other words, the primary capability of long-range bombers is to drop bombs; a carrier battle group is a general-purpose military instrument that can carry out a variety of tasks across the spectrum of conflict.

Some observers have claimed that many of these capabilities are necessary only for the battle group to defend itself. But that argument ignores the reality that sea-control and air-superiority capabilities are crucial to U.S. military operations in general in both crises and regional wars. An earlier chart noted the varied roles of battle groups in crises and contingencies. The next chart looks at the role battle groups play in a regional war.

## **IMMEDIATE MILITARY TASKS FOR REGIONAL WAR**

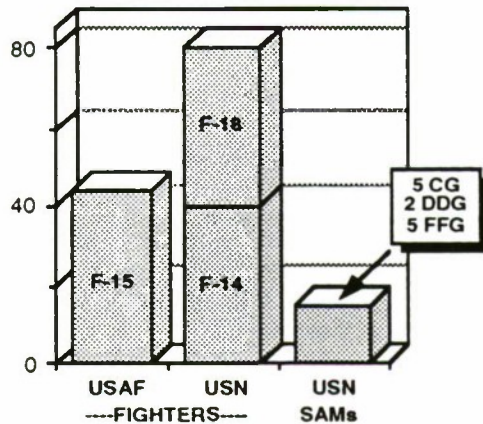
<b><u>TASK</u></b>	<b><u>CVBGs</u></b>	<b><u>Bombers</u></b>
• SECURE LOCs, PORTS, BASES	YES	NO
• STRIKE STRATEGIC TARGETS	YES	YES
• ATTRITE INVADING FORCES		
- BATTLEFIELD AIR SUPERIORITY	YES	NO
- BATTLEFIELD STRIKE MISSIONS	YES	YES
• QUARANTINE EXTERIOR LOCs	YES	NO

The fleet is part of the U.S. combined arms capability that is employed in joint operations involving the forces of all services. In a major regional conflict, probably the most crucial role of the fleet is as an enabling force early in the war. As the Gulf war demonstrated, regional conflicts are likely to occur with little warning (except in hindsight) and in faraway places where the U.S. has few forces on-scene prior to the conflict. Moving forces nearly halfway around the world takes time--weeks for large air forces, months for heavy ground forces. This initial deployment period is a time when the opponent has the initiative and U.S. forces are most vulnerable. Iraq chose not to press these advantages in August 1990--in part because of the deterrent effect of early arriving U.S. forces (particularly two carrier battle groups that were on-scene early--*Independence* on August 6 and *Eisenhower* on August 8). But ultimately Saddam Hussein probably assumed that the U.S. would acquiesce to his seizure of Kuwait. Given the outcome this time, the next Saddam Hussein would definitely think several times before resorting to force--but once the decision was made, he could go for broke and not stop in Kuwait to await the U.S. counterattack.

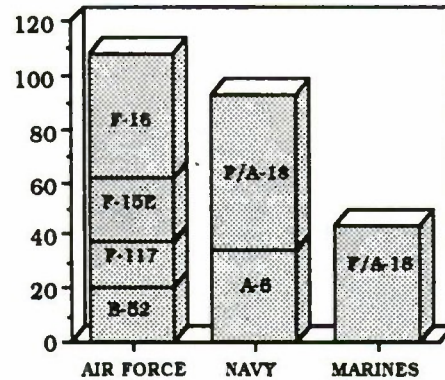
In this case, the U.S. would not have the luxury of over five months to prepare for offensive operations. The immediate military tasks listed above would be crucial. At the top of the list would be securing the air and sea lines of communications to the theater and the bases from which U.S. forces would operate. The U.S. would also want to cut off the enemy's exterior sea and air lines of communication. Concurrently, U.S. forces would mount a strategic strike campaign against enemy war-making potential. Though potentially devastating to the enemy's economy and political control, a strategic campaign would not immediately halt invading forces. The U.S. must also use its airpower to support friendly forces and slow down invading enemy forces. This calls for air superiority over the battlefield and the application of airpower to battlefield targets. Long-range bombers would be a valuable asset in this situation because of their ability to bring considerable payload from long range. Long-range bombers, together with on-scene carrier aircraft and Tomahawk land-attack missiles, could carry the initial strategic air strikes. With appropriate weapons, bombers could also play a role in the battlefield strike missions, particularly against massed armored formations. Strike alone is not enough, however. Both air superiority and sea control are essential. Carrier battle groups would play a major role in these missions in addition to contributing to the strike campaign.



## DESERT SHIELD DATA



Air defenses on-scene at C+3



Strike aircraft on-scene at C+15

The previous chart does not imply that carrier battle groups are the only forces that contribute to key military tasks early in a regional war. Other forces play crucial roles, especially early-arriving ground and land-based tactical air forces. For example, in Operation Desert Shield, early arrival of two brigades of the 82nd Airborne Division and a Marine Expeditionary Brigade established an initial U.S. ground presence in Saudi Arabia and provided security for ports and bases. The buildup of USAF tactical aircraft also proceeded steadily over the first month. Air superiority fighters and airborne surveillance aircraft were the first to arrive; two F-15 squadrons and five AWACS were on-scene within three days of the decision to reinforce Saudi Arabia. Thus, the argument is not that carrier battle groups do it alone, but rather that they provide combat-ready and sustainable forces at a critical time when other forces would be limited. The above charts indicate, for example, that the Navy provided over half the air defense assets available in theater at C+3. Even at C+15, Navy and Marine aircraft still accounted for over half the strike assets in theater-- and these aircraft were fully supported with the logistics, maintenance, and weapons needed for sustained combat.

In some scenarios, the deployment of land-based aircraft could easily be slower due to less favorable base access or unfavorable combat conditions. (In addition, building up a fully sustainable combat capability takes time unless supplies and support equipment are prepositioned.) In other cases, fewer naval forces might be positioned to be on-scene early. So it is not an either/or proposition. The nation requires a balanced military capability that can be effective in a wide range of circumstances. Carrier battle groups, with their multiple warfare capabilities and relative independence from base access, are an essential element of such a balanced force.

## **BOMBING: IS IT DECISIVE?**

- **STRATEGIC BOMBING THEORIES ORIGINATED IN THE 1920s**
- **BOMBING WAS NOT DECISIVE IN WORLD WAR II UNTIL THE USE OF NUCLEAR WEAPONS**
- **THE BOMBING CAMPAIGNS IN KOREA AND VIETNAM WERE NOT AS EFFECTIVE AS EXPECTED AND NOT DECISIVE**
  - Nuclear weapons proved unusable, and conventional weapons were not sufficiently effective
- **DESERT STORM HAS LENT NEW CREDIBILITY TO BOMBING**
- **BUT, THE NATION STILL REQUIRES A BALANCED COMBINED ARMS CAPABILITY TO DEAL WITH A RANGE OF THREATS**
  - In war, the outcome is still decided on the ground
  - The ideal conditions of Desert Storm may not be repeated

Up to this point, the argument has presumed that the U.S. requires a robust combined arms capability. There is a contrary, albeit a minority opinion that strategic bombing can win the war with fairly minimal need for other military capabilities--in which case the U.S. presumably should give up considerable land, naval, and tactical air forces in order to build a bigger bomber force. The debate about the decisiveness of bombing goes back to the days of General Billy Mitchell and the theories of Douhet. World War II was the first large-scale test. The Strategic Bombing survey showed that the bombing campaign against Germany was not nearly as effective as the adherents had predicted and certainly was not in itself decisive. Nonetheless, the success of the bombing campaign against Japan and the advent of nuclear weapons propelled strategic bombing theories to the forefront of post-war U.S. defense thinking, leading to the doctrine of massive retaliation and to the B-36 versus aircraft carrier debates of the late 1940s.

The next 40 years were not so good for bombing advocates. The decisiveness of bombing was discredited by the events of Korea and Vietnam. Nuclear weapons proved unusable, and conventional bombing was not effective enough to decide the outcome. Adherents had excuses, citing political restrictions on the locations and types of targets as the culprits. But the weight of evidence indicated other major reasons--the insufficient lethality of conventional weapons, the ability of the enemy to repair and/or work around bombing damage, and the willingness of the populace to absorb considerable hardship. In other words, bombing failed as a coercive terror weapon because of people's fortitude, and it failed as a decisive military weapon because of limitations of conventional weapons and the nature of the battlefields in Korea and Vietnam.  
[continued on the next page]



(text continued from previous page)

Desert Storm was a different story. The conditions were ideal for a decisive bombing campaign. Iraq possessed a modern industrial infrastructure and relied on conventional mechanized forces. Also, the Iraqis had nowhere to run, and the desert landscape provided few places to hide from precision-guided weapons that modern technology had developed since Vietnam. Given five months to prepare and overwhelming air superiority, coalition air forces unleashed 100,000 sorties in 40 days over an area roughly twice the size of Georgia. Although the onslaught did not force Saddam Hussein to surrender, it decimated his capabilities and demoralized his front-line forces, paving the way for the remarkable 100-hour victory by coalition ground forces.

This outcome certainly breathes new life into the bombing theories. There seems little doubt that bombing will be a central element of U.S. strategy in a future regional war, but that does not necessarily imply the U.S. should shift the balance of forces in favor of strategic bombers--for several reasons. First, even in this near-ideal case for airpower, the outcome of Desert Storm was still decided on the ground. Second, the near-perfect conditions in the Gulf might not be duplicated next time. Finally, greater emphasis on airpower would not automatically equate to more bombers than currently planned. The U.S. already owns 97 B-1 bombers that were not used in Desert Storm but presumably would be more available in a future regional war because of the decreased demand for nuclear deterrence. There is also a good argument for a balance of tactical airpower and long-range bombers, as discussed further on the next chart.



## **STRATEGIC BOMBERS AND TACTICAL AIRCRAFT COMPLEMENTARITY AND SYNERGISM**

### **STRATEGIC BOMBERS**

- LONG RANGE
- LARGE PAYLOAD
- MASS/SHOCK
- STRATEGIC AGILITY

### **TACTICAL AIRCRAFT**

- HIGH SORTIE RATES
- RAPID RESPONSE
- MULTIROLE CAPABILITY
- TACTICAL AGILITY

This chart lists some of the basic characteristics of strategic bombers and tactical aircraft to emphasize unique attributes of each. The main point is that each aircraft type has its strengths. Bombers can deliver large payloads from long range. They can deliver massive attacks in a confined area, which can leave enemy forces and command structure in a virtual state of shock. They are less dependent on overseas bases than land-based tactical aircraft, and they have strategic agility to shift operations rapidly from one part of the world to another.

Tactical aircraft, on the other hand, provide high sortie rates and rapid response. They can mount multiple sorties while bombers are making a single roundtrip from a distant base. High sortie rates and nearby bases also translate into rapid response to emerging situations. Many tactical strike aircraft--the F/A-18, F-16, and F-15E, and the planned AX for example--also have capability for air-to-air missions, as illustrated by the now famous incident in Desert Storm when two F/A-18s on their way to a strike mission shot down two Iraqi MiG-29s and then proceeded with their strike mission. Together with their greater numbers and rapid response, this multirole capability equates to tactical agility for dealing with a variety of fast-breaking tactical situations. Thus, strategic bombers and tactical aircraft can be highly complementary.

They also are synergistic. For example, tactical aircraft can provide strike support to bombers (as they did to the F-117 during Desert Storm) and protection for command-and-control aircraft like JSTARS that could provide tactical targeting information for bombers approaching the theater to participate in battlefield strikes. Nonetheless, bombers and tactical strike aircraft do have some overlapping capabilities, which leads into the third tradeoff suggested in the SASC report: whether the capabilities of the B-2 affect the types and mix of aircraft in the carrier air wing?

## **MODIFY AIR-WING COMPOSITION?**

- **Airwing composition is reviewed regularly and modified in response to resource constraints and to changes in the threat**
- **Tradeoffs are being examined in the A-X development program and COEA**
  - **Degree of stealth**
  - **Range/payload**
  - **Multirole capability**

The third tradeoff mentioned in the SASC report involves the composition of the carrier air wing. The basic idea appears to be that the capabilities of the B-2 bomber to strike deep targets might enable the Navy to settle for a different, presumably less-expensive mix of aircraft. In particular, perhaps the required capabilities of the A-X can be relaxed, or, in the extreme, maybe the Navy could make do with a mix of nonstealthy F-18 and A-6 aircraft.

In fact, air-wing composition is under almost continuous review in response to changes in the threat and the budget. The recent Carrier Airwing Study (CAWS) is an example. The cancellation of the A-12 program forced the Navy to rethink both the design of a follow-on attack aircraft and the mix of aircraft in the carrier air wing. The requirements to maintain the A-6's capability to conduct strike operations at night and in all weather conditions has been reaffirmed, but the review has resulted in the Navy reducing the range/payload requirements for the A-X (relative to the requirements for the A-12), placing more emphasis on air-to-air capability, and stressing affordability. The A-X design is far from fixed, despite occasional articles to the contrary in the press. Airframe tradeoffs are being examined by industry in a concept development phase, and the Navy is conducting a broader cost and operational effectiveness analysis (COEA) that will consider a variety of alternatives. Though not a direct response to the B-2, these changes are consistent with the arguments in the SASC report. In other words, the tradeoff is being addressed by existing programs and studies.

## Part II: Summary

### (1) Reduce CVBG deployments?

- National policy requires forward presence and crisis response.
- Long-range bombers cannot sustain presence.
- Bombing is not an appropriate response for many crises.

### (2) Reduce CVBG force levels?

- CVBGs provide multi-warfare capabilities that are needed in peacetime, crises, and regional conflicts.
- Bombers and CVBGs are not substitutable.

### (3) Modify air-wing composition ?

- DON is examining the tradeoffs.

This chart summarizes the discussion of the SASC tradeoffs at the margin.

The first two tradeoffs are inappropriate because they involve comparison of multimission carrier battle groups with strategic bombers that have a narrower range of capabilities. This does not imply that carrier force levels and deployment patterns are immune from discussion and change. Both the structure and deployment posture of the fleet are changing and will likely continue to do so in response to the changing requirements and resources of the post-Cold-War world; however, the bomber force is not a major factor in these decisions.

In theory at least, the capabilities of long-range bombers are more relevant to the future composition of the carrier air wing and to the issue of the type of aircraft the Navy chooses to replace the aging A-6 medium-attack aircraft. The Navy is addressing these issues in the A-X development program.



## **PART III**

# **COST-EFFECTIVENESS COMPARISONS**

- **EQUAL-COST FORCES**
- **STRIKE EFFECTIVENESS**
  - **Payload**
  - **Sortie rate**
  - **Survivability**
  - **Responsiveness**
  - **Lethality**

The previous section focused on broad considerations that affect the comparison of long-range bombers and carrier battle groups. The main argument was that strategic bombers are not directly comparable with CVBGs because CVBGs carry out a variety of important military tasks that are not suited to strategic bombers. To a degree, the same argument applies to long-range bombers and tactical aircraft. Clearly, however, there is some commonality in the capabilities of strategic bombers and tactical strike aircraft. This section discusses the degree of commonality and makes simple cost and effectiveness comparisons of the B-2 bomber and the A-X.

## **COST**

- **COSTS ARE RELEVANT TO FORCE COMPARISONS**
- **SUNK COSTS ARE FOREVER SUNK**
- **ESTIMATING COSTS IS HARDER THAN IT LOOKS**
  - **COSTS OF NEW PROGRAMS ARE UNCERTAIN**
  - **WHICH COSTS SHOULD BE INCLUDED?**
  - **SAVINGS DEPEND ON THE PRECISE PROGRAM ALTERNATIVES**
- **EQUAL-COST FORCES ARE DESIRABLE WHEN MAKING GENERAL COMPARISONS**

Cost is an important factor, particularly in an era of declining budgets, but estimating potential cost savings is not as straightforward as might seem at first glance. To begin with, history has shown that problems and program stretchouts often lead to higher costs than originally estimated. When comparing different types of systems, however, the uncertainty in specific costs is usually less important than the issue of which costs are relevant to the comparison. One general rule is "sunk costs are forever sunk." In other words, the roughly \$30 billion spent to develop the B-2 and produce the first 15 aircraft has already been spent, and so only the marginal costs of new aircraft are relevant to a decision of how many additional B-2s to buy. Even then, the cost per aircraft depends on the buy size and production rate. This paper focuses on DOD's proposal to buy 60 additional B-2s, for a total force of 75, at an additional cost of roughly \$30 billion.

For Navy aircraft, an appropriate program for comparison is less clear. The Secretary of Defense has endorsed the need to replace the aging A-6 attack aircraft, but a replacement program is not yet clear. The leading candidate is the A-X, which designates a new-design aircraft that presumably would be stealthy. But if an A-X is not developed, the Navy would likely fill out carrier decks with additional F-18E/Fs and perhaps buy additional cruise missiles. In this case, the ultimate cost savings at issue would be the difference between a somewhat uncertain cost of the A-X and those of the as-yet undefined fall-back option.

The message here is that the cost savings associated with a particular tradeoff depend on the detailed program alternatives under consideration. In the case of the B-2 and Navy strike aircraft, the final alternatives are unlikely to be as simple as "buy all of one, sell all of the other." Nonetheless, general cost-effectiveness comparisons between forces can still be illuminating. The goal is to understand whether one alternative appears much better than the other in areas of common capability. In such comparisons, it is desirable to hold cost constant, which is the purpose of the equal-cost forces shown on the next chart.



## COST COMPARISONS

Average cost per aircraft (\$FY91) <sup>a</sup>			
	<u>R&amp;D</u>	<u>Procurement</u>	<u>Total</u>
B-2	(sunk)	\$500M <sup>b</sup>	\$500M
A-X	\$25M	\$100M <sup>c</sup>	\$125M
F-18E/F	\$ 5M	\$ 75M <sup>d</sup>	\$ 80M

a. Flyaway, initial spares, and unique ground support.

b. For proposed buy of 60 additional aircraft.

c. For a buy of 400 to 500 aircraft.

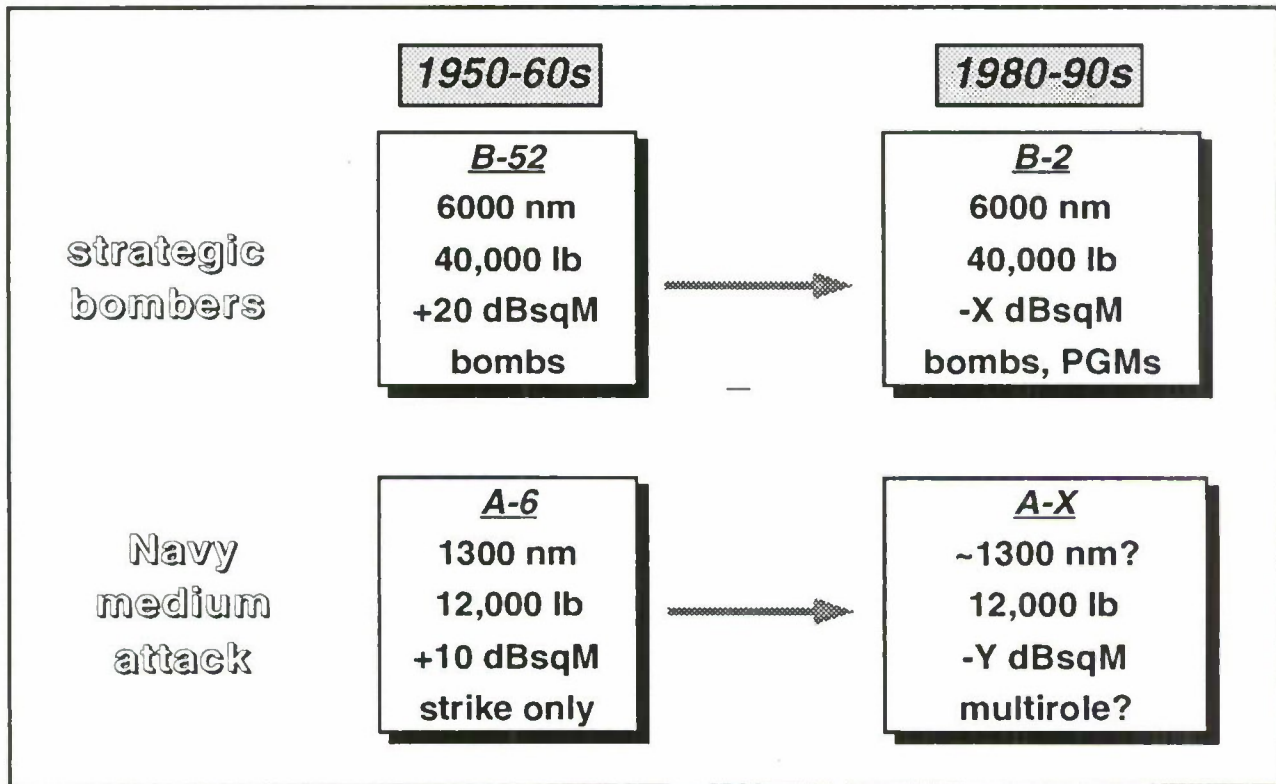
d. For a buy of 1,000 to 1,400 aircraft

***EQUAL COST 60 B-2s = 240 A-Xs or 375 F-18E/Fs***

This chart shows three aircraft forces that are equal in acquisition costs. The costs are in constant FY91 dollars and include research and development, flyaway costs for the basic aircraft, and various nonrecurring flyaway costs for things like initial spares and unique ground support equipment. For the B-2, the costs are for the proposed buy of 60 additional aircraft assuming that costs for R&D and procurement of the first 15 aircraft are sunk. (Prorating these costs over the entire buy would add over \$300 million to the average B-2 cost, but these funds have already been spent or obligated.) Based on data published in the summer of 1991, the average cost for 60 additional B-2 bombers would be about \$500 million. This cost may increase because of the need to fix problems discovered in recent tests, but no estimate is available.

The Navy has established a goal of \$65 million for the average flyaway cost of an A-X. When items such as initial spares and unique support equipment are added, the average procurement cost for the A-X will be about \$100 million. A prorated share of the R&D adds another \$25 million, bringing the average acquisition cost to \$125 million per aircraft. These figures imply a cost ratio of 4 A-Xs per B-2, or 240 A-Xs for the price of 60 B-2s. The chart also shows costs for buying additional F-18E/Fs, which appears to be the most likely strategy for replacing the A-6 in the event the Navy decides not to develop a new aircraft. Because of lower development costs and larger buy sizes, the average F-18E/F cost appears to be about two-thirds that of a new aircraft. Based on the above figures, the Navy could acquire 375 F-18E/Fs for the cost of 60 B-2s, for a ratio in excess of 6:1. For purposes of the comparisons that follow, the A-X was selected over the F-18 to avoid the difficulties in comparing stealthy and nonstealthy aircraft. The cost-effectiveness analysis that follows will compare 60 B-2s with 240 A-Xs.





Before comparing the effectiveness of the B-2 and A-X, it is helpful to look back at their origins. In many respects, the B-2 is an evolutionary replacement of the B-52. Its maximum payload and unrefueled range are similar to those of the B-52. ( Because of its lower specific fuel consumption, however, the B-2 requires less inflight refueling than the B-52.) The B-2 is a stealthy aircraft, whereas the B-52 is not, but one can view this development as restoring the high survivability that bombers enjoyed in the immediate post-war period. For many years, survivability was maintained through flying fast at a very low altitude and employing electronic countermeasures. This approach appears questionable for staying ahead of the threat in the next century. Stealth represents an entirely new approach technologically, but operationally the effect is to restore bomber survivability to a higher level. In the long run, new weapons will be as important to bombers as stealth, because they offer the potential to expand bomber missions to targets that heretofore could be struck efficiently only with nuclear weapons or with tactical strike aircraft.

The A-X is also an evolution in capability, in this case from the A-6 medium-attack aircraft, which dates from the 1960s, only a few years after introduction of the B-52. The A-X will likely have range and payload similar to that of the A-6. It will represent a revolution in the technology of survivability, but operationally the result should be to assure that the high survivability once enjoyed by the A-6 will be restored and maintained well into the future. A more crucial difference may ultimately be the proposed multirole capability of the A-X, which will have some capability for air-to-air missions as well as air-to-ground missions. In sum, both the B-2 and the A-X incorporate revolutionary technology, but overall, both represent evolutions of long-standing, proven capabilities.

## **EFFECTIVENESS FACTORS**

<b><u>Factor</u></b>	<b><u>Comment / Key issue</u></b>
<b>Payload . . . . .</b>	<b>Important for single strike</b>
<b>Sortie rate . . . . .</b>	<b>Important for a campaign</b>
<b>Survivability . . . . .</b>	<b>Robustness of stealth?</b>
<b>Target acquisition . . . . .</b>	<b>Important for mobile/ and responsiveness      emerging targets</b>
<b>Weapons . . . . .</b>	<b>Low-cost PGM for the B-2?</b>
<b>effectiveness</b>	

**Bottom Line: *TARGETS KILLED***

The ultimate measure of effectiveness for strike operations is targets destroyed over the course of a strike campaign. This analysis does not attempt to identify an explicit target set or a detailed strike scenario. Rather, it focuses on the primary factors that would determine targets killed in most strike campaigns--payload, sortie rate, survivability, target acquisition, response time, and weapons effectiveness. Survivability will be addressed first, followed by a discussion of weapons effectiveness and target acquisition. The final portion of this section looks at payload and sortie rates in various scenarios.

## **SURVIVABILITY**

**STEALTH IS REVOLUTIONARY; HOWEVER:**

- IS STEALTH ABSOLUTE?**
- IS STEALTH ROBUST IN THE LONG TERM?**
- WILL SURVIVABILITY IMPOSE TACTICAL LIMITATIONS ON B-2 OPERATIONS?**

The details of survivability depend on classified programs that cannot be included in this paper. Nonetheless, several general points can be discussed. The Navy agrees with the Air Force view that stealth constitutes a revolution in aircraft capabilities and that stealthiness is a strength of the B-2. Thus, the value of stealth is not in question. Rather, the issue is the degree to which stealth resolves all survivability problems. The Navy believes that stealth is not absolute, that the advantages of stealth may be eroded in the future as air defenses are reconfigured in response to stealth, that survivability considerations will affect certain B-2 operations, and that vulnerability of the B-2 once detected will make support from tactical forces desirable in many situations.



## **STEALTH REDUCES THE RISK BUT DOES NOT ELIMINATE IT**

### **Stealthy aircraft could be at risk if:**

- **They fly over a high-performance surface-to-air missile site, such as the Soviet-made SA-10.**
- **They encounter an enemy fighter at close range, where optical or infrared sensors or perhaps even radar have some ability to detect a stealthy aircraft.**
- **Low frequency radars, such as the Soviet Tall Rack VHF radar, could alert enemy fighters to their approach.**

Although the details of stealth are still classified, enough information has leaked into the public domain to conclude that, despite its revolutionary effect on aircraft survivability, stealth technology does not make aircraft invisible. It appears that stealth negates some defense systems entirely and severely degrades others. However, stealthy aircraft still might be vulnerable in special circumstances. For example, the B-2 could be at risk if it flew very near a high-performance surface-to-air missile, such as the Soviet SA-10, or if somehow a fighter aircraft flew close enough to a B-2 to pick it up with optical or infrared sensors, or perhaps even radar. Also, apparently some low-frequency radars may be able to detect stealthy aircraft. Although their resolution is very poor, they could help direct enemy fighters to the general vicinity of approaching B-2s.

Few countries outside the Soviet Union can afford to buy SA-10s, and there may be tactical and technical means of further reducing potential threats. Nonetheless, the B-2 would face some risk if it flew into dense air defenses in a confined area such as might be encountered at the outset of a regional war. When the area is small and enemy assets are at full strength, chance encounters will occur. The A-X would face a similar risk of chance encounters, but, as discussed on the next chart, its vulnerability in an encounter with an enemy aircraft would be lower than that of the B-2.

## **SURVIVABILITY FACTORS**

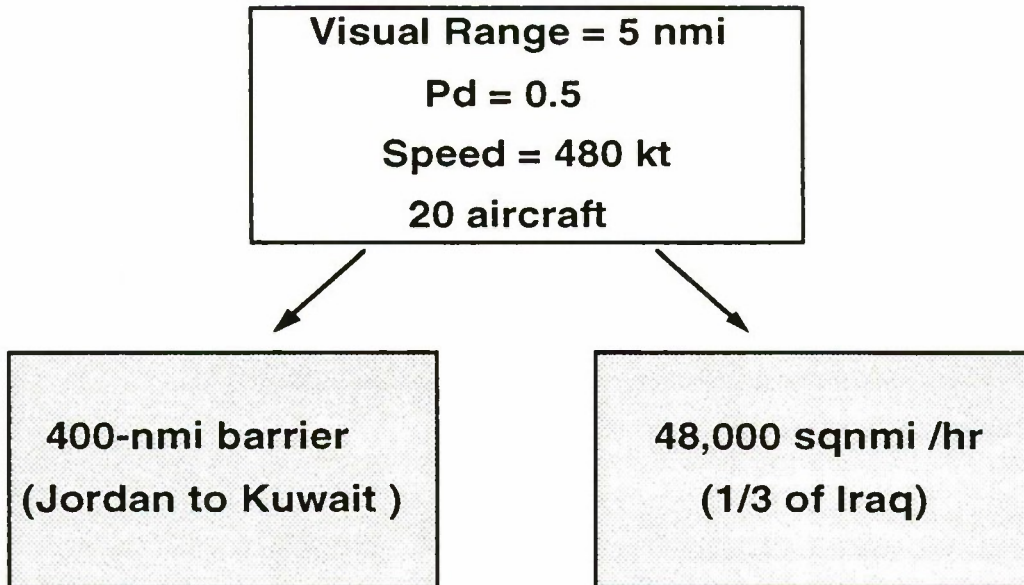
<u><b>FACTOR</b></u>	<u><b>B-2</b></u>	<u><b>A-X</b></u>
<b>OBSERVABLES</b>	<b>VERY LOW ALL ASPECT</b>	<b>VERY LOW ASPECT?</b>
<b>MANEUVER</b>	<b>2-3 g</b>	<b>6-7 g</b>
<b>SPEED</b>	<b>480 kt</b>	<b>540-960 kt</b>
<b>ARMs / AAMs</b>	<b>?? / NO</b>	<b>YES / YES</b>
<b>STRIKE SUPPORT</b>	<b>?</b>	<b>YES</b>

This chart compares the basic survivability features of the B-2 and the A-X. The main point is that B-2 survivability depends fundamentally on avoiding detection. Its all-aspect very low radar cross section, infrared suppression, and other stealth features give the B-2 a tremendous advantage in avoiding detection, but if a B-2 is detected, it's in trouble. It can't outrun or outmaneuver pursuers, and it has electronic countermeasures but not defensive weapons.

The A-X will also depend heavily on stealthiness, which should be comparable to the B-2 but may not be all-aspect, depending on the final design. The A-X, however, will also be fast, highly maneuverable, and capable of carrying both air-to-air missiles and antiradiation missiles (for use against the radars of surface-to-air missile systems). In addition, the A-X will operate as part of a carrier air wing that can supply strike support when necessary. In short, even if the A-X is detected, the odds would still be in its favor.

The survivability comparisons hinge on the issue of under what conditions the B-2 might be detected and engaged. The B-2's stealthiness provides great advantages in avoiding engagements, but, as the next chart indicates, the effect is not absolute.

### VISUAL SEARCH ILLUSTRATION



For example, stealth aircraft might be at risk during the day when visual detection is possible. Concern about this possibility was almost certainly a major reason why all F-117 sorties during Desert Storm were flown at night. The above stylized calculation indicates that visual detection by fighters is a possibility when visibility is good, as it usually is at the high altitudes the B-2 will fly, and when a number of enemy aircraft are operating in a relatively small space. The result is consistent with more realistic and complicated visual detection analysis performed by CNA for Navy aircraft.

The risk of daytime operations is probably acceptable for one-time operations such as the B-2's nuclear strike mission against the Soviet Union. But the level of risk would be much greater for repeated conventional strikes into a confined area against full-up air defenses. In such a campaign, B-2 operations would likely be restricted to night-time until air superiority had been established by tactical forces.

The potential risk to the B-2 would be reduced as the war progressed and enemy air defenses were degraded. In addition, any tactical forces on-scene could lend strike support. During Operation Desert Storm, for example, F-117s derived support from electronic warfare aircraft, which jammed enemy radars. The importance of that support is not clear given the relatively poor performance by Iraqi air defenses, but it could prove valuable in other cases. The A-X would automatically have strike support, when needed, as an integral part of a carrier air wing. Navy forces on-scene and early arriving land-based tactical aircraft could also support B-2 operations, if needed, which is another reminder of the potential synergism between long-range bombers and tactical forces.



## **SURVIVABILITY OBSERVATIONS**

- **STEALTH IS GREAT, BUT**

---
- **A STEALTHY AIRCRAFT IS NOT INVISIBLE**
- **IF THE B-2 IS DETECTED, IT'S IN DANGER**
- **EVEN A SMALL ATTRITION RATE IS UNSAT**

---
- **DAYLIGHT OPS ARE RISKY; EVEN AT NIGHT, SUSTAINED UNSUPPORTED OPS ENTAIL RISK**

---
- **B-2 WOULD BENEFIT FROM STRIKE SUPPORT PROVIDED BY TACTICAL AIRCRAFT**

In sum, stealth is a revolution in air operations that has been demonstrated in combat. However, stealthy does not mean invisible. Stealth aircraft are susceptible to detection during short-range encounters, certainly by visual means during the day and perhaps by infrared or radar at night. If the B-2 does become involved in a close encounter, it is in danger. Because even a small attrition rate is unsatisfactory in a sustained conventional bombing campaign, these facts imply that B-2 should avoid situations that entail even a moderate degree of risk, which certainly appears to include unsupported daylight operations early in the war, and might also apply to B-2 aircraft searching for tactical targets with its synthetic aperture radar.

One final point related to stealth concerns its longevity. Defenders are exploring a variety of ways to erode the effects of stealth. This is an area where sorting out scientific fact from science fiction is difficult. The stealthiness of Navy submarines has proven very durable, but the prognosis for stealth aircraft appears less certain given the technical aspects of the stealth-counterstealth equation. The prospects are further complicated by the tactical setting of a sustained conventional strike campaign. With the short-range weapons now envisioned, the B-2 would have to fly repeatedly into the teeth of the defenses. Any erosion of its stealth capabilities could put the aircraft at serious risk during unsupported operations. In sum, despite the many advantages of stealth, sustained B-2 operations without tactical support may prove risky, which is one more argument for maintaining a balanced aviation force.

## EFFECTIVENESS FACTORS

<u>Factor</u>	<u>Comment / Key issue</u>
Payload .....	Important for single strike
Sortie rate .....	Important for a campaign
Survivability .....	Robustness of stealth?
Target acquisition ..... and responsiveness	Important for mobile/ emerging targets
Weapons ..... effectiveness	Low-cost PGM for the B-2?













**Bottom Line: *TARGETS KILLED***

The above discussion of survivability implies that, despite the revolutionary advantages of stealth, the B-2 would still need support from tactical forces for a sustained conventional campaign against full-up enemy air defenses. Conceivably, however, the B-2 could still assume more of the strike role and let tactical air forces focus on air superiority and specialized tactical strike missions. This tradeoff would depend on the relative efficiency and effectiveness of bombers and tactical strike aircraft in a range of strike missions, which is the subject of the rest of this section. The discussion begins with weapons effectiveness, target acquisition, and responsiveness, which determine the applicability of aircraft to various targets and missions.

Weapons characteristics affect the efficiency and effectiveness of aircraft against fixed targets and some types of mobile targets. Desert Storm illustrated that the revolution in precision-guided weapons has greatly increased the lethality of conventional airpower. Target acquisition and response time become important against many types of mobile and emerging targets whose existence and/or location are recently discovered. The next three charts discuss how these factors affect the B-2 and the A-X.



## TARGET/MISSION APPLICATION

	<u>B-2 CAPABILITY</u>		<u>COMMENT</u>
	<u>Near-term weapons</u>	<u>Future weapons</u>	
• <u>FIXED/PREPLANNED</u>			
AREA (e.g., troop positions)			The Inertially aided weapons programmed for the B-2 are adequate for many targets, but <u><i>a new low-cost PGM is needed</i></u> because the B-2 will not deliver laser-guided bombs.
SOFT (e.g., buildings)			
HARD (e.g., aircraft shelters)			
• <u>MOBILE/EMERGING</u>			
MASSED (e.g., armored column)			Terminally guided submunitions are effective vs. massed targets.
ISOLATED (e.g., dispersed SCUDs)			Target acquisition and rapid response are key factors.
ENGAGED (i.e., close-air support)			Bombers are not well suited to close-air-support missions.

good                      poor  
 Legend : 

This chart is the first of three that relate to weapons effectiveness, target acquisition, and response time. It summarizes an assessment of the B-2's capability in preplanned missions against fixed targets and in rapid-response missions against mobile and/or emerging targets. Any chart of this nature suffers somewhat from lack of detail and a degree of subjectivity, but two main points are clear:

The first point concerns the B-2's conventional weapons capabilities. The only existing weapons for the B-2 are unguided bombs and cluster munitions. These weapons are effective against soft area targets, but, due to relatively poor accuracy, are not very efficient for use against many point targets, particularly hard targets such as aircraft shelters. The Air Force is taking steps to remedy this deficiency. Two types of weapons are already in development and will be available in the near term. One is inertially aided munitions (IAMs), which add a low-cost inertial guidance kit to existing weapons. The result is improved accuracy, but still not as good as existing precision-guided munitions (PGMs) such as the laser-guided bombs used so effectively during Desert Storm. (The B-2 does not have a laser designator, and apparently the Air Force does not intend to develop one because an expensive redesign of the aircraft would be required.) In the near term, the only PGM available to the B-2 is the Tri-Service Standoff Attack Missile (TSSAM), which is a classified standoff weapon intended for a variety of applications. However, because of its high cost--over a million dollars per copy or roughly as much as a Tomahawk land-attack cruise missile--TSSAM will probably be restricted to a limited target set. [continued on next page]



[continued from previous page]

As a result, inertially aided munitions will be the primary weapon for most targets. IAMS are fairly effective against soft targets and, when used in patterns to compensate for inaccuracy, also against hard targets. However, their efficiency in terms of targets killed per weapon delivered is less than that of PGMs for many targets, which accounts for the less-than-perfect rating for the B-2 against point targets in the near term.













To remedy this potential shortfall, the Air Force has initiated development of a new class of moderate-cost autonomous PGMs for use by both the B-2 and tactical aircraft. The current concept envisions a "target-looking" sensor that could recognize and acquire preprogrammed targets once delivered to the general vicinity of the target. This type of autonomous PGM would not only improve accuracy but also provide off-track delivery capability. Most of the technologies being examined for the terminal guidance--including imaging infrared (IIR), millimeter wave (MMW), synthetic aperture radar (SAR), and laser radar (LIDAR)--would also be less sensitive to weather than laser-guided bombs. The desirability and apparently the technical feasibility of such a weapon are not at issue, but the ultimate cost is uncertain.

The bottom line for fixed targets can be summarized as follows: The B-2 should be fairly effective against most fixed targets with programmed IAMS; however, maximum effectiveness and efficiency require the planned follow-on development of a new PGM to compensate for the B-2's inability to employ laser-guided bombs and to provide a capability for rapid delivery of multiple weapons against dispersed targets.

The story for mobile and emerging targets is different. In this case, target acquisition and responsiveness are at least as important as weapons effectiveness. The effectiveness and efficiency of strategic bombers against such targets depend on the density of the target set and its position relative to friendly forces. For relatively dense target sets, such as a large armored column, the B-2 should be fairly effective, even with existing unguided cluster weapons. Effectiveness will increase in the near term due to the development of terminally guided submunitions, such as the sensor-fused weapon (SFW). SFW is an IR-guided submunition for use against vehicles. The B-2 could carry up to 16 tactical munition dispensers, each of which would carry a number of SFWs. The result is the potential for multiple kills per sortie against a dense formation of vehicles, once the target location is known. The B-2 itself has the capability to acquire such targets with its radar, although initial target locating information is more likely to come from external intelligence sources.

The effectiveness and efficiency of the B-2 are much lower against more isolated targets, such as a mobile Scud launcher, because target acquisition is much more difficult and the large payload less helpful. Nor is the B-2 particularly well-suited for close-air-support missions against targets engaged with friendly forces. The requirements for close coordination with ground forces, visual target acquisition, and rapid response are not well-matched with the strengths of strategic bombers.

## OVERALL STRIKE EFFECTIVENESS (ASSUMING FUTURE WEAPONS)

• <u>FIXED/PREPLANNED TARGETS</u>	<u>B-2</u>	<u>A-X</u>	
AREA (e.g., troop positions)			B-2 is good for mass attack.
SOFT (e.g., buildings)			Assumes a low-cost PGM is developed for the B-2; otherwise, B-2 rating drops.
HARD (e.g., aircraft shelters)			A-X can employ LGBs.
• <u>MOBILE/EMERGING TARGETS</u>			
MASSED (e.g., armored columns)			Terminally guided submunitions are effective vs. massed targets.
ISOLATED (e.g., dispersed Scuds)			Target acquisition and rapid response favor tactical aircraft.
ENGAGED (i.e., close-air support)			Bombers are not well-suited to close-air-support missions.

good                      poor  
 Legend : 

This chart extends the previous one to compare the B-2 and the A-X in target/mission application, assuming that planned weapons are developed by both the Navy and the Air Force. Both aircraft should be effective in preplanned missions against fixed targets. The B-2 would be more appropriate for carpet bombing area targets with unguided ordnance, whereas a tactical aircraft like the A-X would be more efficient in striking widely separated targets, but overall, with future weapons both tactical aircraft and long-range bombers will be effective against a wide range of fixed targets.

For mobile and/or emerging targets, the greater number and more rapid response of tactical aircraft make it the weapon of choice in most cases. One exception is massed formations of vehicles when target acquisition may be available from external sources and the bombers can effectively employ their large payload. For more isolated targets and for close-air-support missions, however, tactical aircraft are clearly better suited than strategic bombers.



## RESPONSIVENESS

(Time to deliver weapon to an emerging target)

	<u>FROM BASE</u>	<u>AIRBORNE</u>
A-X	1 - 2 hr <sup>a</sup>	< 9 min. <sup>c</sup>
B-2	2 - 8 hr <sup>b</sup>	< 22 min.

a. Depends on CV location.

b. Basing in theater - at intermediate overseas basing (e.g., Diego Garcia)

c. Respond to emerging target in 200 x 200 n.mi. area for 1 B-2 vs. 4 A-Xs, which represents equal-cost level of effort.

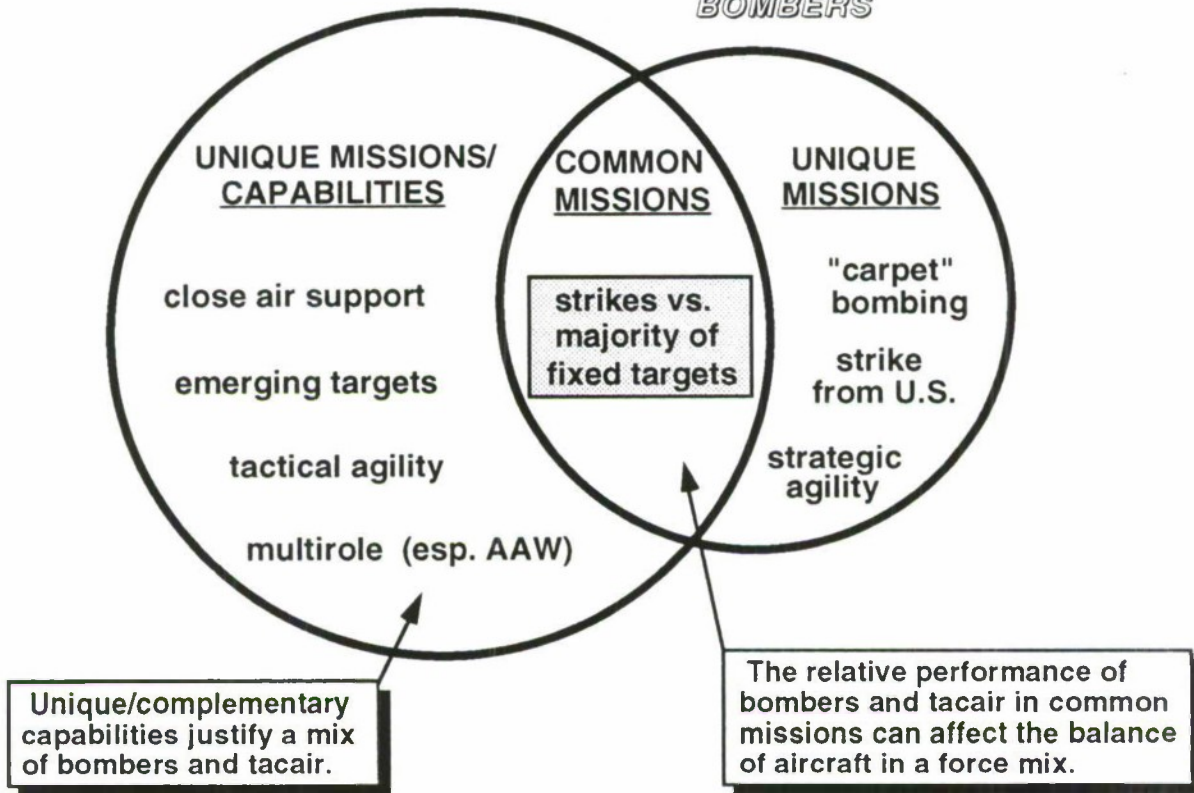
This chart provides a simple illustration of the differences in responsiveness between tactical aircraft and long-range bombers. The first case is for aircraft in a rapid response posture at their base. Because tactical aircraft are generally based close to the action, they can respond within about an hour. Long-range bombers, on the other hand, will operate from more distant bases in theater or from bases outside the theater. During Desert Storm, for example, 16 B-52s operated from Jeddah in western Saudi Arabia, which is about 800 n.mi. from Baghdad. The other B-52s operated from Diego Garcia, Moron (Spain), and Fairford (UK), which are roughly 3,000 n.mi. from the target area. The aircraft in theater could respond in about two hours, but those outside the theater would require at least eight hours. (A B-2 responding from the planned B-2 bases in the U.S. would require 16 hours.)

In a situation requiring immediate response, some type of airborne posture would be required. The second case in the above chart compares equal-cost B-2 and A-X forces in a stylized situation in which aircraft maintain an airborne alert in an area 200 x 200 n.mi. The response times listed above are for the maximum distance an aircraft would have to fly to respond to an emerging target. The difference in the results is due somewhat to the higher speed of the A-X but more to its greater numbers. At first glance, it may seem that bombers would have a compensating advantage of longer endurance, but this would not be true in practice unless bombers were operating from nearby bases. For example, a B-2 flying from Diego Garcia to Iraq would require refueling to have any significant time on station. The same refueling assets would be used to extend the endurance of the A-X. Crew endurance should not be a factor since both aircraft would have a two-person crew. Moreover, the A-X would likely have a higher sortie rate because it would not have to spend 16 hours transiting to and from base.



## *TACTICAL AIRCRAFT*

## *BOMBERS*



This chart serves as a transition into the final topic in this part of the paper. Much of what has gone before points to the complementarity of tactical aircraft and strategic bombers. Because of their more rapid response and greater numbers, tactical aircraft are superior for close air support and for most missions against mobile/emerging targets. In addition, most tactical strike aircraft provide some multirole capability, particularly in air-to-air warfare. As pointed out in the survivability discussion, support from tactical aircraft would be helpful to strategic bombers, including the B-2. Bombers, of course, also provide some unique capabilities due to their long range and large payloads. Large payload makes bombers ideal for carpet-bombing area targets with unguided weapons. Long range enables bombers to strike from the U.S. and gives them strategic agility to rapidly shift their focus from one theater to another.

These unique and complementary capabilities clearly justify maintaining a mix of tactical strike aircraft and strategic bombers for conventional contingencies. They do not, however, automatically justify the current mix. To address the force-mix issue, it is necessary to examine the common missions and capabilities of bombers and tactical aircraft to see if one or the other is much more effective. If that turns out to be the case, then some shift in the force balance would be justified even though each aircraft type provides unique capabilities. Thus, the final part of this paper examines cases where both bombers and tactical aircraft are potentially well suited--i.e., in preplanned strikes against a majority of fixed targets. The ultimate measure of effectiveness is targets killed; however, given future weapon developments, targets killed should be roughly proportional to payload delivered, which is simpler to calculate and compare.

## **PAYLOAD DELIVERED**

**AVAILABLE AIRCRAFT**

**X**

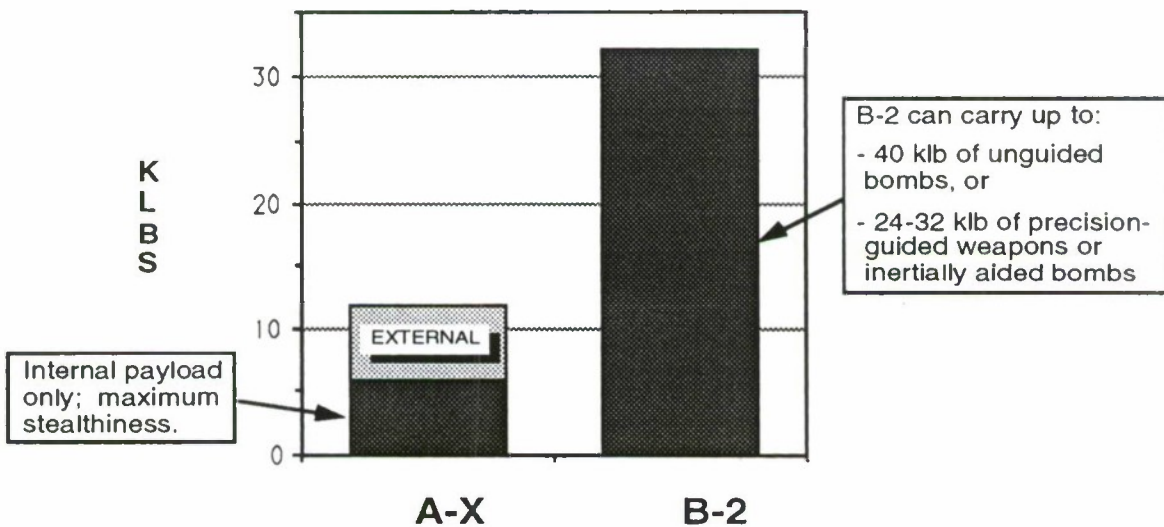
**PAYLOAD**

**X**

**SORTIE RATE**

Payload delivered over the course of a strike campaign depends on the number of aircraft available for the operation times the payload per aircraft times the number of sorties flown over the course of the campaign. The following charts will examine each factor for the B-2 and for the A-X. Some of the factors will depend on the nature of the comparison and the scenario assumed. The goal is to understand under what conditions one force might have clearly greater capability.

## PAYLOAD

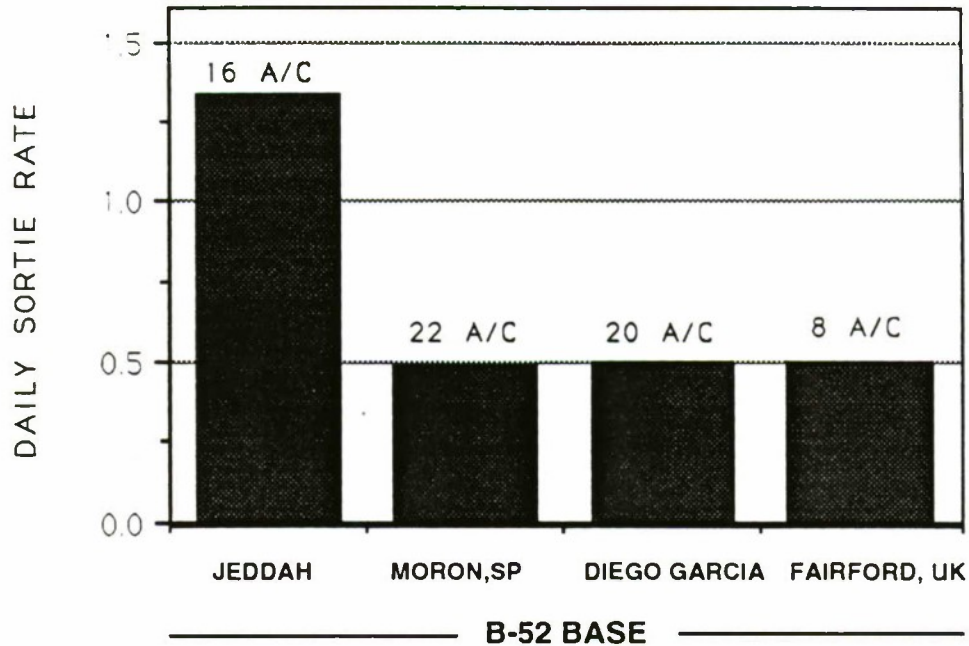


Payload is a strong point of strategic bombers. For nuclear missions, bombers typically carry a payload of about 24,000 pounds, but their capacity is even greater for conventional missions. Both the B-52 and the B-2 can carry 40,000 pounds of Mk-82 500-pound general-purpose bombs. The Mk 82 is probably the weapon of choice for carpet-bombing large area targets, but far more accurate weapons are needed for most targets. As mentioned earlier, the Air Force is developing more accurate 500-pound and 2,000-pound-class weapons for delivery by bombers and tactical aircraft. Current plans call for the B-2 to carry up to 48 of the 500-pound weapons and 16 of the 2,000-pound weapons for a total payload of 24,000 to 32,000 pounds. The calculations that follow assume that the aircraft carries 32,000 pounds.

The payload for the A-X is based on its Tentative Operational Requirement (TOR), which calls for a total payload of 12,000 pounds--the same as for the A-6E aircraft it will replace. Not all of this payload can be carried in an internal low-signature configuration. The TOR calls for an internal payload of 4,500 to 8,000 pounds. The calculations that follow will assume that the A-X can carry an internal payload of 6,000 pounds, or less than one-fifth that of the B-2. This difference in payload accounts for the observation that a fairly small number of bombers can deliver as much payload as the strike aircraft in an entire carrier air wing on a single strike. Payload is only one factor, however; total payload delivered over the course of a strike campaign also involves the sortie rate, which is addressed in the next several charts.



# **CUMULATIVE AVERAGE B-52 SORTIE RATE DURING OPERATION DESERT STORM** (Based on Air Tasking Order )



Sortie rates of bombers are strongly affected by the length of their missions, as indicated by the above data for B-52 bombers in Operation Desert Storm. The 16 bombers that operated in theater averaged one-and-a-third sorties per day during the campaign, whereas bombers flying from the intermediate bases--Diego Garcia, Spain, and the United Kingdom--flew one sortie every other day. The difference is explained in large part by distance. Roundtrip distances and flight times were about 2,000 n.mi. and 5 hours for bombers in theater and 6,000 n.mi. and 14 hours for bombers from the other three bases. For a flight from planned B-2 bases in the U.S., the corresponding figures are 12,000 n.mi and 28 hours. If sortie rates were inversely proportional to mission time, this would lead to a sortie rate of one every four days from the U.S. Some efficiency is likely, however, so that a sortie rate of one every three days is probably achievable and will be assumed in the calculations that follow.

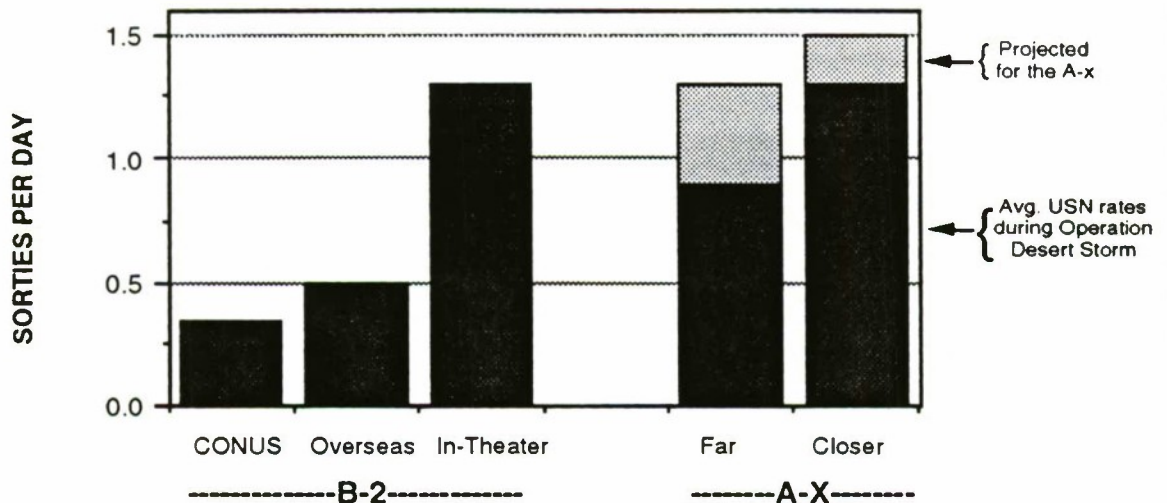
## A-X SORTIE RATES

<u>SOURCE OF ESTIMATE</u>	<u>FAR</u>	<u>CLOSER</u>
AVERAGE DESERT STORM DATA FOR NAVAL COMBAT AIRCRAFT	0.9	1.3
PROJECTED FUTURE CAPABILITY FOR THE A-X SQUADRONS	1.3	>1.5

Sortie rates for naval aircraft are more complicated. They are affected not only by the distance to the targets and maintenance factors, but also by "deck constraints" associated with carrier operations. Desert Storm provides a data point on the overall effect of these factors. Aircraft carriers operating from the Red Sea averaged 0.9 sortie per embarked combat aircraft, whereas carriers operating in the Persian Gulf averaged 1.3 sorties per day per embarked combat aircraft. In the calculations that follow, these two numbers will be used as baseline sortie rates for "far" and "closer" operating areas.

The Navy believes that the A-X will achieve higher sortie rates for two reasons. First, target assignments and tanker availability limited Navy sortie rates below their full potential during Desert Storm. Second, almost half of the Navy strike aircraft in Desert Storm were F-18s, which have short range and require considerable tanking. Refueling operations for a strike group add to the mission time, and sometimes tankers are not available to support all potential sorties. The longer range of the A-X will reduce these constraints. In addition, the A-X is expected to have lower maintenance requirements than current aircraft. The Navy expects mission-capable A-Xs to fly two to three sorties per operating day, depending on range and the type of mission. When adjusted for aircraft carrier standdown days and aircraft mission-capable rates (0.75 to 0.8 during Desert Storm), these figures equate to average sortie rates in the range of 1.3 to 2.1 per embarked aircraft per day. The 2.1 figure is appropriate only for shorter ranges than experienced during most of Desert Storm. As a conservative estimate, 1.5 sorties per day is assumed for "closer" operations; the 1.3 figure is assumed for "far" operations.

## SORTIE RATE ASSUMPTIONS (for 30-day campaign)

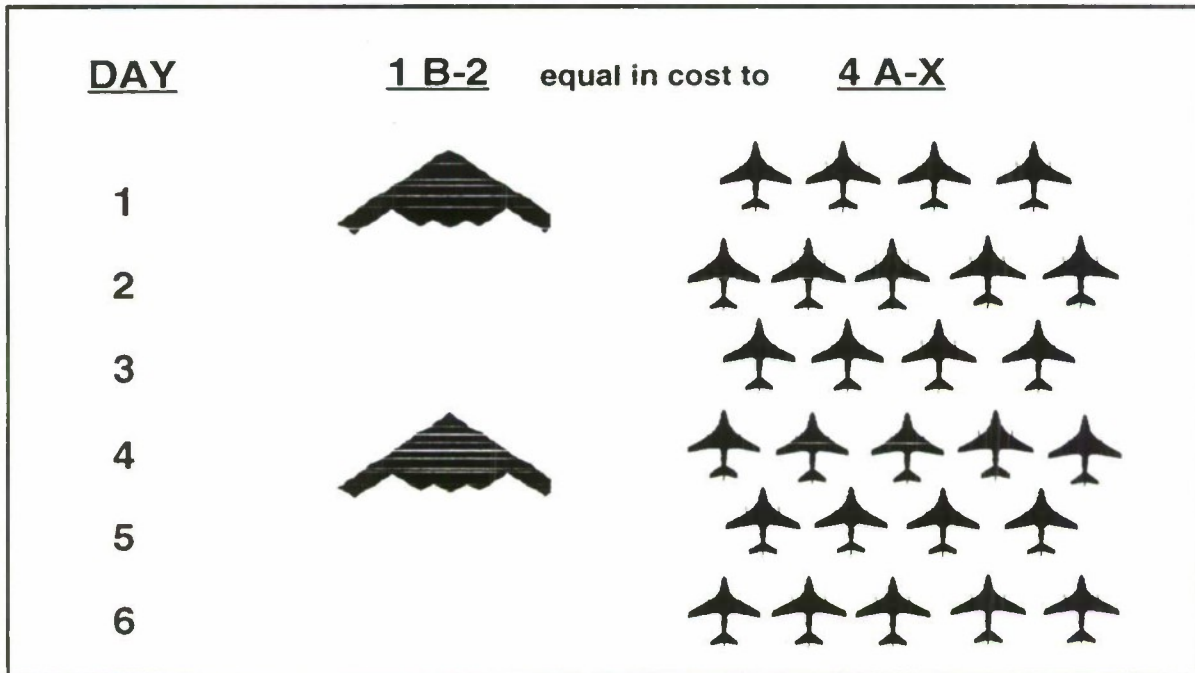


This chart summarizes the sortie rates used in the calculations. The B-2 numbers for in-theater and overseas basing are based on Desert Storm data for bombers. The sortie rate for CONUS basing is derived from these data as explained earlier. For naval aircraft, two sets of numbers are shown. The lower numbers are based on Desert Storm data for carrier-based combat aircraft. The higher numbers reflect improved capabilities of the A-X.

The higher set of numbers for the A-X raises the question of whether the B-2 will achieve higher sortie rates than B-52s in Desert Storm. The B-2 is projected to require less maintenance than either the B-52 or the B-1, which could lead to reduced turnaround times between sorties. However, there are two reasons why sortie rates may not change, particularly for longer missions. For such missions, mission time is a dominant factor. Cruise speed of the B-2 is expected to be similar to that of the B-52, so that mission times should not change. In addition, it is likely that the B-2 will fly primarily at night, as discussed later in this paper. If this is the case, a few hours difference in turnaround rates would not affect sortie rates from distant bases. Based on these arguments and the lack of other information, the analysis will assume that the B-52 sortie rate numbers apply to the B-2. [The study group believes that this approach is justified, but it potentially leaves the analysis open to a charge of "cooking the books" in favor of Naval aircraft. Thus, the contribution of the higher A-X sortie rates will be clearly delineated so that readers who do not accept the Navy argument can ignore this case.]



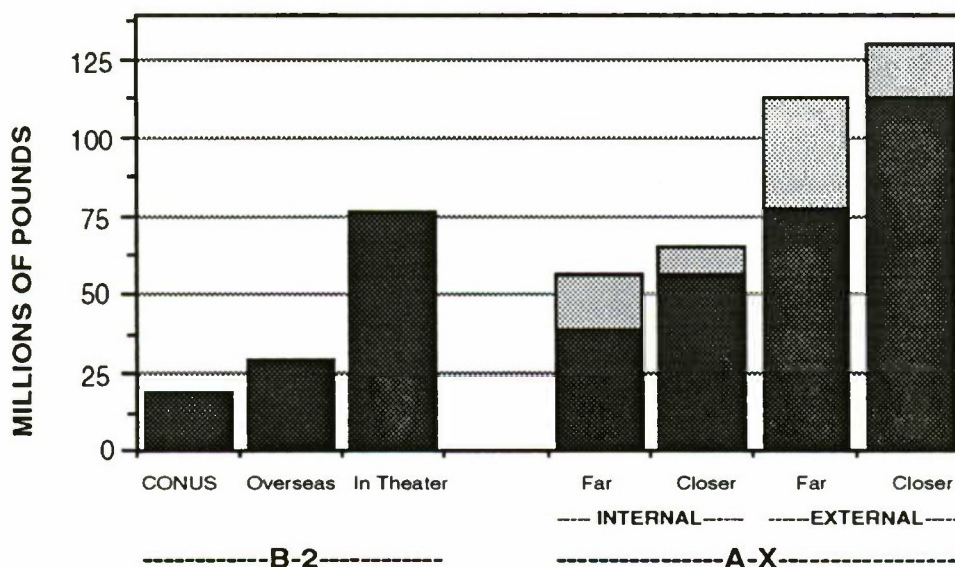
## SORTIES TO THE GULF DURING THE FIRST SIX DAYS



The greater sortie rates of tactical aircraft compared with bombers operating from distant bases is a major advantage. This chart is a visual representation of the relative sortie-generation rates of equal-cost B-2 and A-X aircraft. Flying from CONUS, a B-2 could mount two sorties to the Persian Gulf in six days, whereas the equal-cost ratio of four A-Xs could deliver at least  $4 \times 6 \times 1.1 = 27$  over the same period, assuming the overall average Desert Storm sortie rate. For the projected A-X sortie rate, the number would be as high as  $4 \times 6 \times 1.5 = 36$ .

Sortie rate is important, but by itself is an incomplete picture of overall effectiveness. In other words, the above graphic, although accurate, is not a fair comparison of the A-X and the B-2. Similarly, the dramatic pictures and statistics that emphasize the large payload and long range of bombers on a single strike are just as true, but just as incomplete. A more balanced and complete picture requires looking at payload delivered over the course of a campaign, as shown in the next several charts.

### PAYLOAD DELIVERY POTENTIAL IN 30 DAYS (Equal-Cost B-2 and A-X Inventories)



The above chart shows the amount of payload delivered in a 30-day strike campaign based on the payload and sortie rates described in previous charts. The B-2 force consists of 60 aircraft; the A-X force contains 240 aircraft. Total payload delivered is measured in millions of pounds. For naval aircraft, the dark bar represents the results for Desert Storm sortie rates; the light gray bar represents the additional payload that could be delivered with the expected A-X sortie rates.

Several points are apparent from this chart. First, payload delivered by bombers is sensitive to the location of their bases. The B-2 can indeed bomb Baghdad from Kansas, but not that frequently. Second, the A-X payload delivered depends on the location of the aircraft carrier and whether conditions enable the aircraft to carry external ordnance. In every case, however, the A-X force can deliver more payload than the comparable B-2 force based in the U.S. or at intermediate overseas bases. The reason is sortie rates. For example, 8 B-2s from the U.S. can deliver more payload on a single strike than a 16-plane A-X squadron even if the A-X can carry ordnance externally. However, over the course of a campaign, the A-X squadron would deliver 2.1 to 3.4 times more payload depending on the strike distance and sortie-rate assumptions.

This chart does not include one crucial advantage of bombers, however. Because of their intercontinental range, in theory the entire B-2 force could be made available to support the theater commander, whereas only those A-X squadrons embarked on aircraft carriers in-theater would be a factor. The next several charts show the results for a range of cases.



### FORCES AVAILABLE FOR OPERATIONS

	<u>B-2</u>	<u>A-X</u>
EQUAL-COST INVENTORY	60	240
FRACTION NOT AVAILABLE	.20	.25
AVAILABLE AIRCRAFT	48	180
FRACTION USABLE BY THE THEATER COMMANDER	1.0	0.2 - 0.8 *

\* Depends on scenario, esp. warning time

Availability is the product of two types of factors. Some aircraft will not be available for operations because they are in depot maintenance or are being used for training, R&D, or other purposes. Historically, the fraction of aircraft in these categories has ranged between 30 and 40 percent. Both the B-2 and A-X are designed for less time in depot maintenance. The Air Force is also examining new training strategies, and the Navy may do the same for the A-X. Thus, the fraction of aircraft available for operations will increase. The B-2 will probably have a slight advantage due to a greater opportunity to switch aircraft from training to operations. The analysis that follows assumes that 80 percent of the B-2 inventory and 75 percent of the A-X inventory are available for operations. For this equal-cost comparison, these figures translate into 48 B-2s and 180 A-Xs, which would support 11 A-X squadrons of 16 aircraft.

The other facet of availability is the fraction of operationally available aircraft that can be employed by the theater commander. Because of the B-2's ability to operate from distant bases, potentially the entire B-2 force would be available for use by the theater commander. In contrast, only those A-X squadrons on aircraft carriers in theater would be immediately useful. The actual number varies considerably depending on warning time and deployment patterns. Results for several cases are shown on the next series of charts.

## **LONG-WARNING SCENARIO SIMILAR TO DESERT STORM**

### **Number of Aircraft Usable by the Theater Commander**

	<u>Availability</u>	<u>Case 1</u>	<u>Case 2</u>
<b>B-2</b>	• from U.S.	20	0
	• overseas	20	40
	• in-theater	20	20
<b>A-X</b>	• in-theater	96	128
	(far/closer)	(32/64)	(48/80)

This chart presents two cases for a scenario, like Desert Storm, in which the U.S. has many months to move forces into theater prior to combat operations. Case 1 for the A-X represents the number and locations of aircraft carriers in Operation Desert Storm. Case 2, which has two additional aircraft carriers, represents an upper bound to carrier availability in this situation. In both cases, A-X aircraft carry only internal payload during the first week and external payload thereafter.

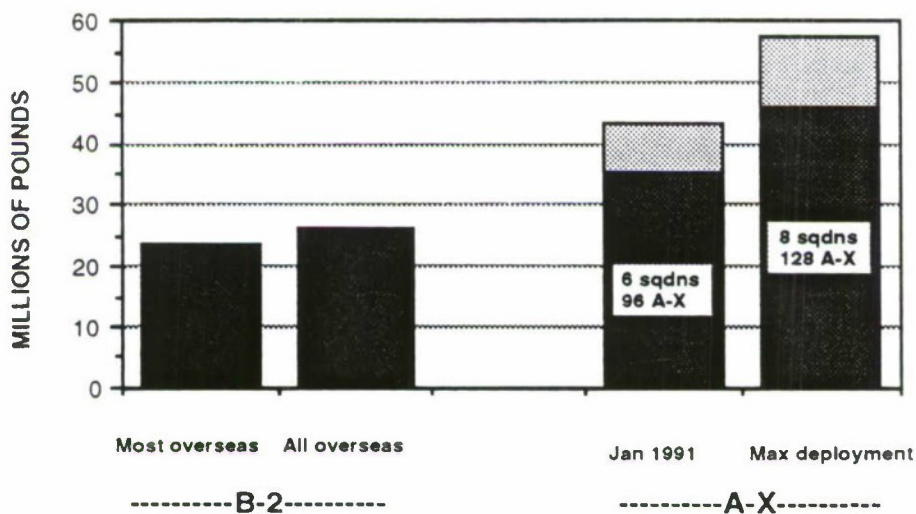
Two cases are also shown for the B-2. In both cases, all operational B-2s are employed; the difference is in the basing. Case 2 assumes that 20 B-2s are based in-theater (four more than was the case for B-52s in Desert Storm) and that all other operational B-2s are based overseas at intermediate bases. Case 1 is a more conservative basing scheme in which the number of aircraft overseas is limited--for political or operational reasons. [Note: In both cases, the chart shows the beddown for the entire force of 60 available B-2s. This is necessary to calculate the marginal contribution of the 48 operational B-2s at issue in this comparison.]

The results of these assumptions are shown on the next chart.



## LONG-WARNING SCENARIO (SIMILAR TO DESERT STORM)

### Payload Delivered in the First 30 Days



This chart shows the amount of payload delivered in a 30-day campaign for the Desert Storm cases described on the previous chart. Under these circumstances, the A-X aircraft in-theater deliver more payload than the 48 available B-2s at issue in this equal-cost comparison. In view of the previous payload/sortie data, this result is not surprising, because the scenario assumptions provide time for many aircraft carriers to arrive in-theater, whereas the number of B-2s in-theater is constrained by basing considerations. If more B-2s could be based in-theater, the B-2 total would be greater. In the unlikely but best case that almost all B-2s were based in-theater, the bomber total would roughly equal that of the A-X.

The A-X superiority in this scenario is noteworthy because it runs counter to common intuition that bombers would deliver more payload. Nonetheless, if the U.S. has months to move forces and ordnance to theater, develop strike plans, and prime all its forces for a coordinated offensive, the outcome is probably not in doubt regardless of the exact amount of payload delivered. The more crucial case is what happens in scenarios where little warning is available. In these scenarios, fewer aircraft carriers will be in-theater and the long range of bombers should be particularly valuable. The next two charts examine the numbers.



## SHORT-WARNING SCENARIO SIMILAR TO DESERT SHIELD

### Number of Aircraft Usable by the Theater Commander\*

<u>availability</u>		<u>no warning</u>		<u>15 days of warning</u>
B-2	• from U.S.	60 - 8*		40 - 8*
	• overseas	0 - 36		20 - 32
	• in-theater	0 - 16		0 - 16
		<u>Aug. 1990</u>	<u>maldeployed</u>	
A-X	• in-theater	32 - 48*	16 - 48*	48 - 80*
	(far/closer)	(32/16)	(32/16)	(32/48)

\* Left-hand numbers are for D-Day, right-hand numbers are for D+30

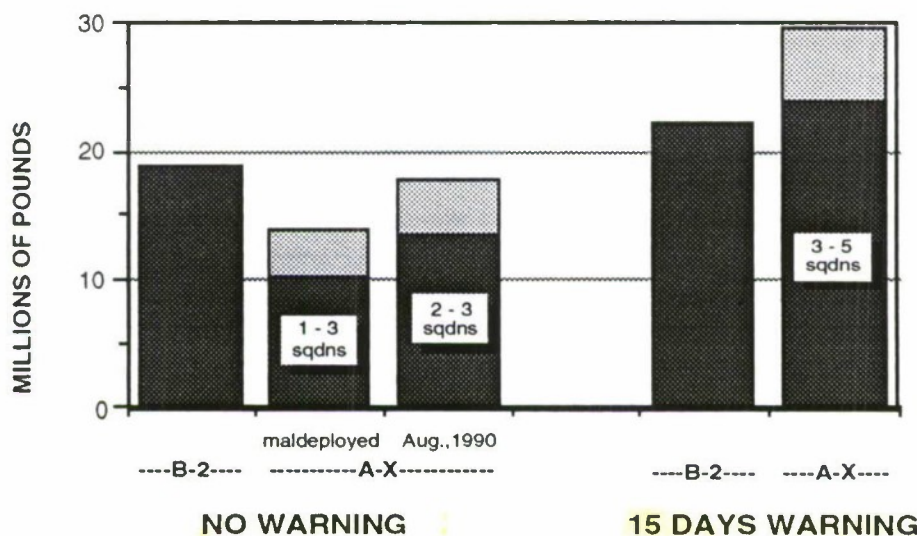
This chart addresses a short-warning scenario, similar to the situation that would have existed had Iraq invaded Saudi Arabia the second week in August, 1990. In fact, the first case for the A-X reflects the aircraft carrier force levels that were available for Desert Shield. Two CVs were on-scene at the outset (C-day, August 7, the day the U.S. began the movement of forces to Saudi Arabia)--*Eisenhower* in the Red Sea and *Independence* in the North Arabian Sea. *Eisenhower* was joined by *Saratoga* at C+15. A fourth carrier arrived at C+30, and so would not have contributed to the first 30 days of action. The third case for A-X represents a scenario in which the U.S. has two to three weeks warning and takes aggressive action. In this case, three CVs could be on-scene by the beginning of hostilities (D-day), and one of the Red Sea carriers would have time to move to the Persian Gulf. Two additional CVs could arrive by D+15, one from the Atlantic Fleet and another from the Pacific Fleet. On the other hand, carrier forces could be caught in a worse position, as illustrated in the middle case, where no carrier was deployed in the Indian Ocean. Only one CV is available at D-day, with two additional CVs arriving at D+15, one from the Atlantic Fleet and the other from the western Pacific. In all three cases, the A-X carries only internal payload during the first week and external payload thereafter.

When no warning is available, all B-2s would likely be in the U.S. on D-day, but could redeploy forward over the next several weeks. The example in the chart assumes that B-2s deploy first to Diego Garcia, then to the United Kingdom, and finally to Saudi Arabia after bases are secured and logistics arrangements made. If some warning is available, deployment could begin prior to D-day. The example in the chart assumes that B-2s deploy to Diego Garcia prior to hostilities and that other deployments occur more rapidly once hostilities commence. The consequences of these assumptions for payload delivery are shown on the next chart.



## SHORT-WARNING SCENARIO (SIMILAR TO DESERT SHIELD)

### Payload Delivered in the First 30 Days



This chart summarizes the results for the short-warning cases described on the previous chart in terms of the amount of payload delivered during the first 30 days. Again, several observations are apparent. First, the results for the A-X are more variable than for a long-warning scenario because of the wider variation in the number of aircraft carriers in-theater. Second, the advantage in payload delivered depends on the circumstances. When several weeks' warning is available, fleet commanders can move additional aircraft carriers into the theater, in which case the A-X will generally deliver more payload. In the intermediate cases--where there is little warning but CVs are positioned as in Desert Shield or the carriers are malpositioned but there is a week or two of warning--payload delivered is roughly a tossup. On the other hand, in a case where there is no warning and the carriers are malpositioned, the global reach of the B-2 allows it to deliver more payload during the first 30 days.

The main point to take away from this chart is the approximate comparability of the B-2 and the A-X in these scenarios, not the winner or loser of the numbers game in a specific situation. In any short-warning scenario, U.S. forces would initially be at a serious disadvantage. The theater commander would be desperate for any and all airpower, including long-range bombers, naval aircraft, and early-deploying land-based tactical aircraft. So long as their payload-delivery capabilities are roughly comparable, the unique and complementary capabilities of different air forces would be more important than modest differences in payload delivered.

## ARITHMETIC FOR SHORT-WARNING SCENARIO

	Weeks				A/C days	Sorties flown in 30 days	
	1	2	3	4			
<b>A-X on scene</b>							
-- Far	16	16	32	32	720	648-936	(0.9 - 1.3 sorties/day)
-- Closer	16	16	16	16	480	624-720	(1.3 - 1.5 sorties/day)
						1272-1656	→ <b>13.8-17.9 Million lb</b>
<b>B-2 Basing**</b>							
-- CONUS	60	40	24	8	900*	300*	(0.33 sorties/day)
-- Overseas	0	20	36	36	510*	255*	(0.50 sorties/day)
-- Theater	0	0	0	16	30*	40*	(1.33 sorties/day)
						595	→ <b>19.0 Million lb</b>

\*\* Basing for entire force of 75 B-2s (60 available).

\* Net figures for 60 (48 available) B-2s, not including contributions of 15 (12 available) B-2s already procured.

The result that the A-X can deliver as much payload as the B-2 in many short-warning scenarios is at odds with the conventional notion that bombers can deliver much more payload than carrier-based aircraft. This chart lays out one set of numbers so that the reader can follow the calculations. The numbers represent a no-warning scenario in which A-X availability matches the CV availability that existed on August 7, 1990, and the B-2 force is based initially in CONUS but subsequently moves mostly overseas.

The results reflect the ability of tactical aircraft to fly many more sorties than bombers operating from the U.S. or intermediate bases overseas. If most of the bomber force were moved into theater, the B-2 could achieve similarly high sortie rates, but this seems unlikely in short-warning scenarios for several reasons--including the scarcity and potential vulnerability of in-theater bases and the logistics difficulties in supporting bomber operations at bases that are unprepared (in the sense of ordnance stockpiles, specialized maintenance equipment, etc.)

This chart concludes the quantitative comparisons of the B-2 and the A-X. The next two charts present a summary "scorecard" of the comparisons and summary observations about the comparisons.



## STRIKE EFFECTIVENESS SCORECARD

WEAPONS  
EFFECTIVENESS .....

USAF/USN plan to provide a broad range of weapons for the B-2/A-X. The B-2 needs a low-cost PGM.

TARGET ACQUISITION  
RAPID RESPONSE .....

Tacair is more responsive due to larger numbers and close-in basing.

SURVIVABILITY .....

- B-2 has all-aspect stealth—but still some risk in sustained ops vs. full-up defense. Support from tactical forces desirable.
- A-X more robust: stealth+speed+AAMs.

RANGE/PAYLOAD .....

Strength of heavy bombers:  
- Long range = strategic agility  
- Big payload = single strike potential

SORTIE RATE .....

Strength of tactical aircraft:  
- Many sorties = tactical agility and cumulative strike potential

This chart presents a summary scorecard for strike comparisons:

**Weapons Effectiveness:** Both the Air Force and the Navy have comprehensive plans to develop a range of weapons for future aircraft. The Air Force plan to develop a new, autonomous PGM is particularly important for the B-2 because it cannot employ any of the existing low-cost PGMs.

**Target Acquisition and Rapid Response:** Because of their greater numbers, nearby basing, and more varied mission profiles, tactical aircraft are more responsive tactically and better suited for some types of targets/missions than strategic bombers.

**Survivability:** Stealth is a major strength of the B-2 and the A-X, greatly increasing their survivability compared with the aircraft they will replace, but stealth does not equate to no risk. The B-2 and the A-X would face some risk in a sustained campaign against full-up defenses. For the A-X, those risks are mitigated by its speed, maneuverability, air-to-air weaponry, and support from other forces in the CVBG. Similar support is desirable for sustained operations by the B-2, and a CVBG is one likely source early in the war.

**Range/Payload and Sortie Rate:** Range/payload is a strength of bombers that enables them to strike quickly from CONUS and to shift operations rapidly from one theater to another. The higher sortie rates of tactical aircraft lead to tactical agility and better capabilities against many types of mobile/emerging targets. When the combination of range/payload and sortie rate is considered, strategic bombers and tactical aircraft can deliver roughly comparable payloads over the course of a strike campaign.

## **STRIKE EFFECTIVENESS: SUMMARY OBSERVATIONS**

- In most cases, the A-X can deliver as much or more weapons payload per dollar than the B-2 over the course of a strike campaign.
- The B-2 and A-X offer complementary capabilities at both the tactical and the operational levels.

### **B-2**

- LONG RANGE
- LARGE PAYLOAD
- MASS/SHOCK
- STRATEGIC AGILITY

### **A-X**

- HIGH SORTIE RATES
- RAPID RESPONSE
- MULTIROLE CAPABILITY
- TACTICAL AGILITY

This chart presents two summary observations about comparisons of the B-2 and the A-X. First, in common missions, the A-X and B-2 are roughly comparable. In most situations the A-X can deliver as much or more payload per dollar as the B-2 over the course of a strike campaign. Because of this broad comparability in common missions, consideration of the A-X and B-2 should focus less on their commonality than on their complementarity. It is clear that the B-2 and A-X offer important complementary capabilities at both the tactical and operational level, as indicated by the characteristics highlighted in the shaded boxes.

Each aircraft type has its strengths. For example, bombers can deliver large payloads from long range. They have strategic agility to rapidly shift operations from one part of the world to another. Tactical aircraft, on the other hand, can mount multiple sorties while bombers are making a single round trip from a distant base. High sortie rates and nearby bases also translate into rapid response to emerging situations. Many tactical strike aircraft, including the A-X, also have the capability for air-to-air missions. Together with their greater numbers and rapid response, this multirole capability equates to tactical agility for dealing with a variety of fast-breaking tactical situations.



## **PART IV**

### **CONCLUDING DISCUSSION**

- **MULTIMISSION CAPABILITIES**
- **COMMON MISCONCEPTIONS**
- **PAYLOAD DELIVERED**
- **COMPLEMENTARITY OF FORCES**

This concluding section reviews the main themes of the preceding sections, which are listed on the above outline--the multimission capability of Navy battle groups; the persistence of important misconceptions in many previous comparisons; the competitiveness of the A-X with the B-2 in delivering payload; and the ultimate complementarity of a balanced force of long-range bombers, land-based tactical aviation, and carrier-based aircraft.

## **MULTIMISSION CAPABILITY**

- **THE U.S. REQUIRES A COMBINED ARMS MILITARY FORCE THAT IS CAPABLE ACROSS A RANGE OF CONTINGENCIES**
- **BATTLE GROUPS ARE CAPABLE MULTIMISSION FORCES THAT ARE VALUABLE IN PEACETIME, CRISES, AND REGIONAL WAR**
- **STRATEGIC BOMBERS ARE ALSO VALUABLE, BUT ARE SUITED PRIMARILY TO BOMBING OPERATIONS**
- **BOMBERS AND BATTLE GROUPS ARE NOT SUBSTITUTABLE**

Much of the discussion in part II of this paper revolved around the argument that Navy battle groups are multimission forces that provide a range of military capabilities required to support U.S. diplomatic objectives in peacetime, respond effectively to a variety of crises, and serve as an enabling force for joint operations in a regional war. The range of capabilities of strategic bombers is much narrower, limited primarily to strike operations. Bombing capability is certainly valuable, as illustrated in Desert Storm, but is not the whole answer. The U.S. must maintain a combined arms capability of which carrier battle groups are an integral part. In short, comparing long-range bombers to a battle group is like the proverbial comparison of apples and oranges.



## COMMON MISCONCEPTIONS

<u>MISCONCEPTION</u>	<u>ACTUAL CAPABILITY</u>
Long-range bombers can deliver much more payload than tactical aircraft	<ul style="list-style-type: none"><li>• <b>Higher sortie rates enable tactical aircraft to deliver as much payload as bombers over the course of a campaign.</b></li></ul>
All battle groups do is deliver a few bombs; their other capabilities are purely defensive "overhead".	<ul style="list-style-type: none"><li>• <b>The A-X can deliver as many bombs per dollar as the B-2.</b></li><li>• <b>More important, battle groups provide air superiority and sea control, which are essential military tasks for a variety of crises and regional scenarios.</b></li></ul>

This paper cited two important misconceptions that often occur in these types of discussions. One is the notion that payload on a single strike is an appropriate measure of comparison of bomber and tactical aircraft. Although it is true, as has appeared in the trade press, that eight B-2s from CONUS could deliver as much payload as an existing carrier air wing, this statistic is misleading. First of all, future air wings will have greater payload delivery capability, as the A-X is introduced and current fighters are replaced by multirole aircraft. But more important, the sortie rate of bombers from CONUS to the likely trouble spots of the world is, at most, one-fourth that of naval aircraft. To stretch the point, a B-2 from the moon could deliver as much payload in a single strike as a number of tactical aircraft, but what counts is the ability to deliver payload over the course of a strike campaign--and that depends on payload capacity, sortie rates, and the availability of aircraft to the theater commanders. When these factors are included, the A-X can deliver as much payload per dollar as the B-2 over a wide range of situations.

A second misconception is that the only real output of a battle group are the bombs that its aircraft deliver to the target; everything else, from the fighter aircraft in the air wing to the surface combatants that accompany the carrier, is there only to protect the carrier and so constitutes an enormous overhead cost for naval strike operations. This view is simply incorrect, unless one buys into the theory that bombing can solve every problem. That certainly is not true in most crises, when a variety of factors often prohibit or constrain bombing. In a regional war, bombing is an important factor, as illustrated by Desert Storm, but the ability to establish air superiority and sea control are essential for effective use of ground forces that are ultimately required to settle the outcome. The multiple capabilities of a battle group are essential for these crucial enabling tasks in a regional war.

## **PAYLOAD DELIVERED**

**THE A-X IS COMPETITIVE WITH THE B-2 IN PAYLOAD  
DELIVERED PER DOLLAR:**

- **EQUAL FIREPOWER IN MOST INITIAL OPERATIONS**
- **GREATER FIREPOWER IN EXTENDED OPERATIONS**

If the analyst can avoid the temptation to pick a measure that favors one's favorite system--i.e., one-time payload for bombers and sortie rate for tactical aircraft--the earlier quantitative comparisons indicate that strategic bombers and tactical strike aircraft are roughly comparable in payload-delivery potential.

The analysis showed that the A-X aircraft can deliver comparable payload per dollar in most cases and more payload in cases where there was some warning or the bombing campaign lasted more than about 30 days. It also confirmed that strategic bombers have an advantage in a scenario where carrier forces are malpositioned and there is no warning. On the other hand, in cases of ambiguous warning, carrier forces can be more easily repositioned than bombers or other land-based forces. In other words, both bombers and naval aviation are generally comparable in delivering payload, and they have important advantages in different circumstances of concern to U.S. defense planning. This complementarity in the realm of planning scenarios is just one facet of the overall complementarity of the nation's air forces, which is the final theme of this paper.





The overall theme of this paper is that the nation's air forces are complementary. The diagram above is one way of illustrating that naval aviation, long-range bombers, and land-based tactical aircraft, although overlapping in some capabilities, each possess unique capabilities that are both important and complementary. One dimension involves the availability of forces and their reaction to warning. The long range, large payload, and stealthiness of the B-2 gives the U.S. a capability to initiate strike operations immediately, even in a surprise attack scenario where other forces are maldeployed. On the other hand, the inherent mobility of naval forces and their relative freedom from political constraints enables naval aviation to maintain an on-scene deterrent presence and to reposition forces in uncertain and ambiguous situations like the one that existed in the Gulf in late July 1990.

Another dimension of complementarity occurs at the operational level. With their large payload, bombers can achieve the effects of massed attacks, whereas tactical aircraft provide high sortie rates and are highly responsive to the tactical commander. In addition, tactical aircraft possess a wide range of air-to-air and defense suppression capabilities that can provide valuable support to bomber operations.

In sum, the U.S. derives many advantages from balanced aviation forces that maintain a degree of tactical and operational complementarity. Although the force levels and even the precise mix of forces are subject to change in a changing world, a balanced aviation force remains central to the U.S. defense posture.